APPENDIX E CONSTITUENT CONCENTRATIONS §257.103(F)(1)(IV)(B)(3)

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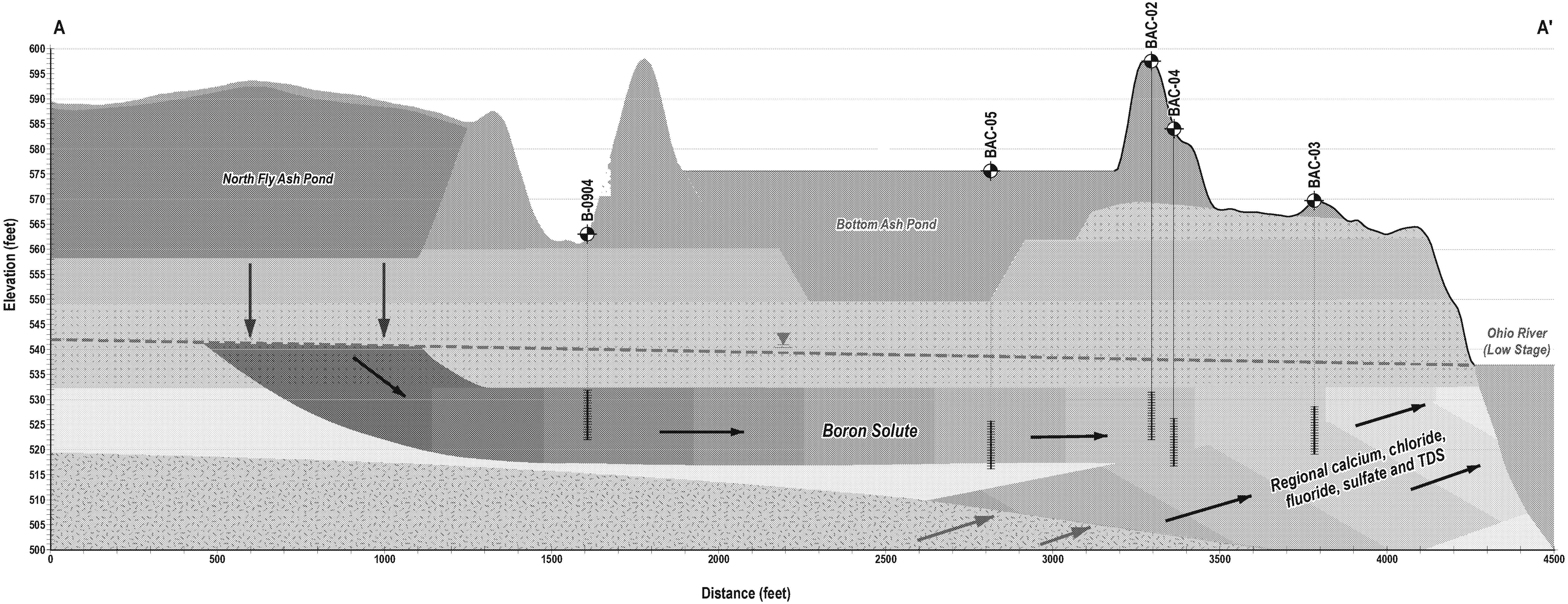
ERRATA SHEET

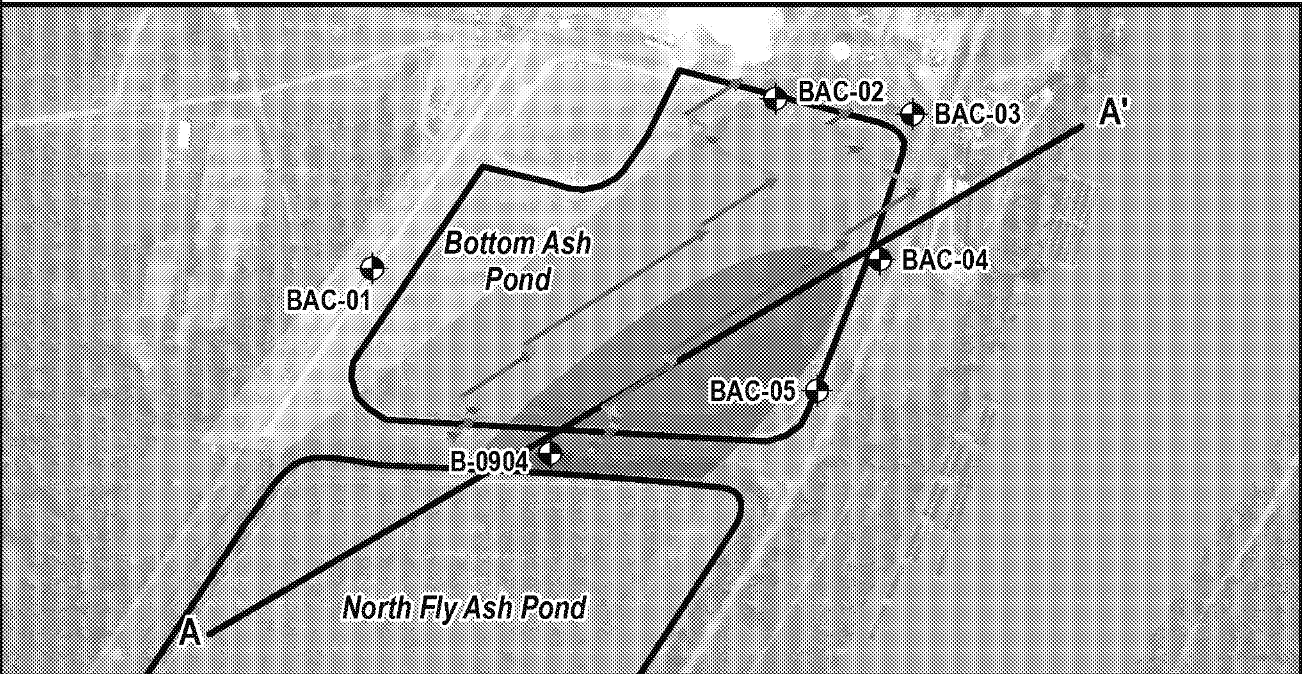
Gavin Bottom Ash Pond
2019 Annual Groundwater Monitoring and Corrective Action Report
Gavin Power Plant
Cheshire Ohio

16 October 2020

The following revisions have been incorporated into the **2019 Annual Groundwater Monitoring and Corrective Action Report dated** 30 January 2020, as described in the following table.

Revision Number	Location	Description of Change
1	Appendix A – Gavin Bottom Ash Pond First Semi-annual Sampling Event of 2019 Alternate Source Demonstration Report	Replace Figure 5-1 (page 53 of 102 in this document) which inadvertently showed monitoring wells screened in bedrock, with an updated version of Figure 5-1 (page 2 of 102 in this document), which accurately shows the actual placement of the Bottom Ash Pond monitoring wells, which were screened in the sandy unconsolidated aquifer. Monitoring well depth and screened interval is confirmed by boring logs in the well network certification completed in July 2016.
2	Appendix B – Gavin Bottom Ash Pond Second Semi-annual Sampling Event of 2019 Alternate Source Demonstration Report	Replace Figure 5-1 (page 87 of 102 in this document) which did not include monitoring wells, with an updated version of Figure 5-1 (page 3 of 102 in this document) showing the monitoring wells screened in the sandy aquifer.
3	Appendix B – Gavin Bottom Ash Pond Second Semi-annual Sampling Event of 2019 Alternate Source Demonstration Report	Replace Figure 5-2 (page 88 of 102 in this document) which did not include monitoring wells, with an updated version of Figure 5-2 (page 4 of 102 in this document) showing the monitoring wells screened in the sandy aquifer.





Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted Low River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca, Cl, F, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Bottom Ash Pond First Semi-Annual Sampling
Event of 2019 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

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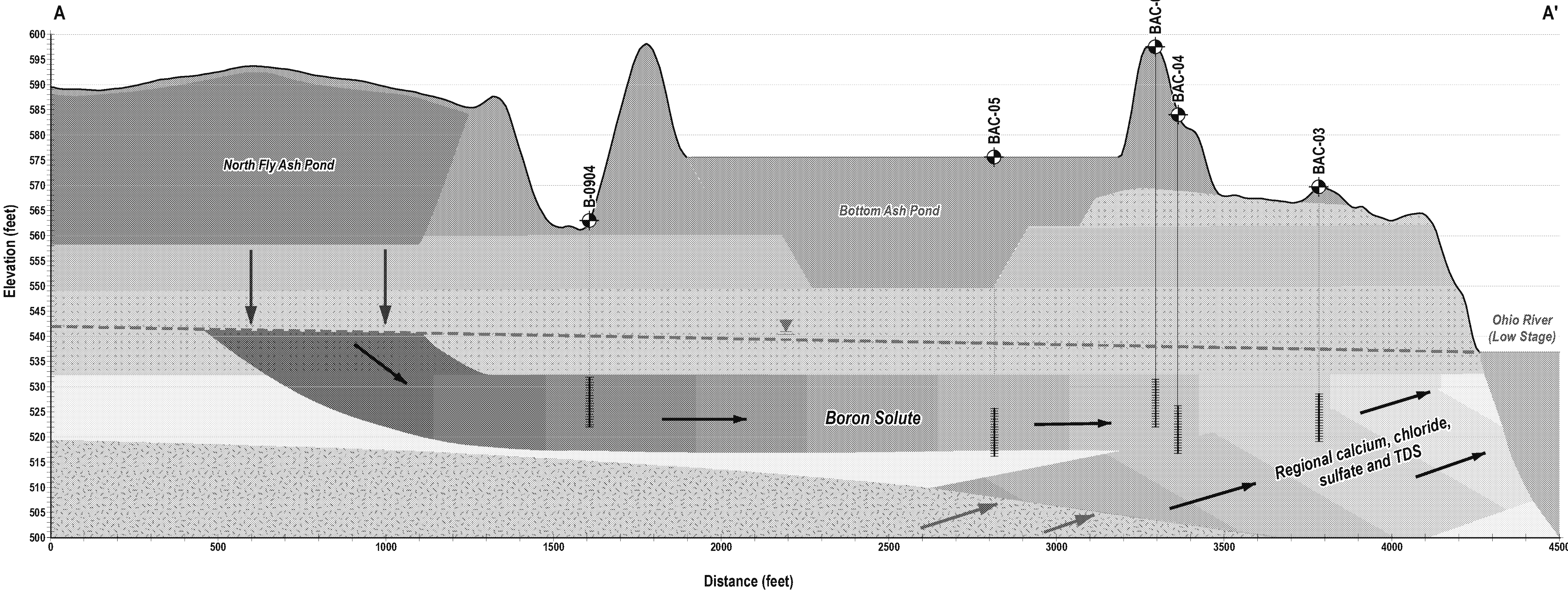

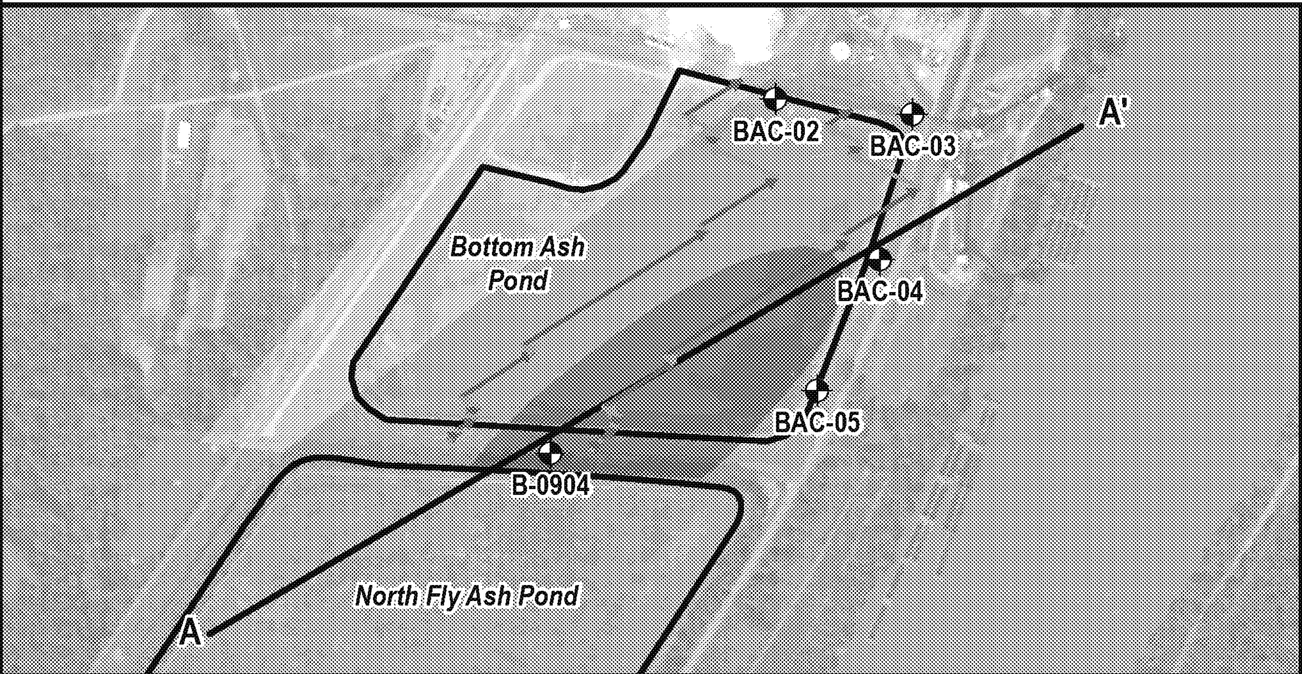

Legend

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- Cross Section Location
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- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca^{2+}, Cl^{-}, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

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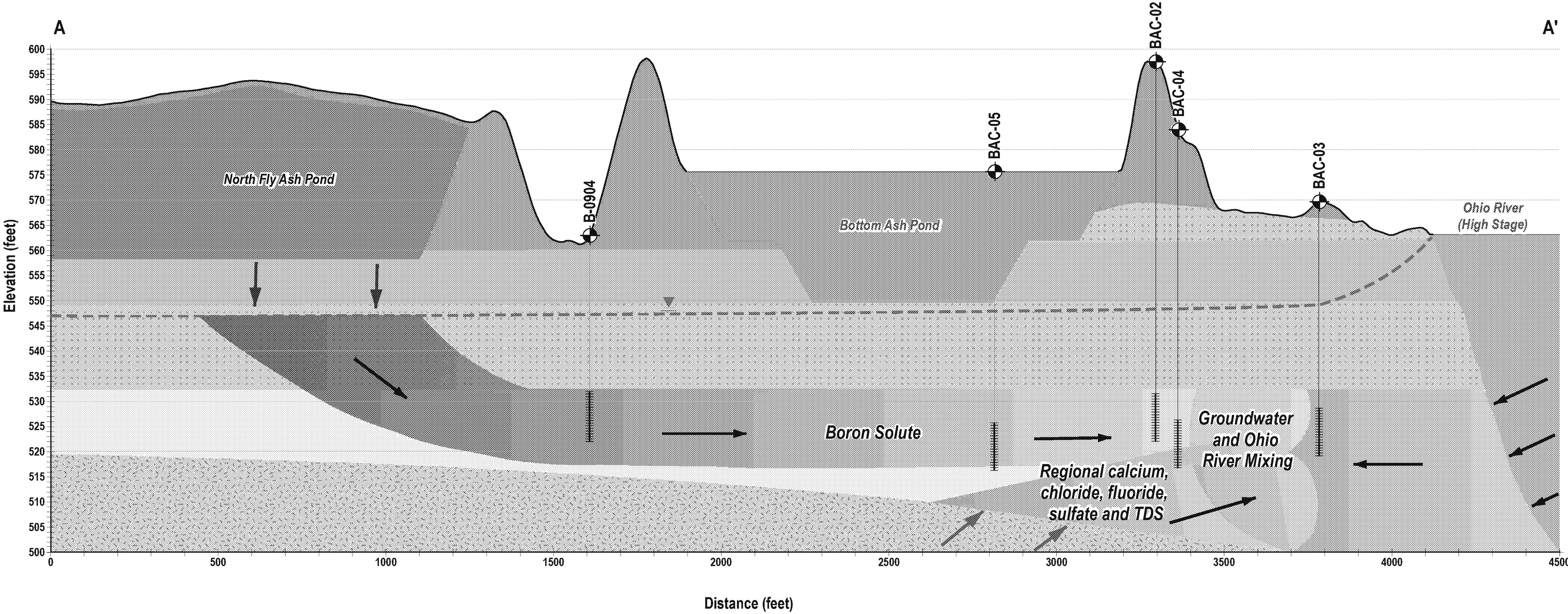

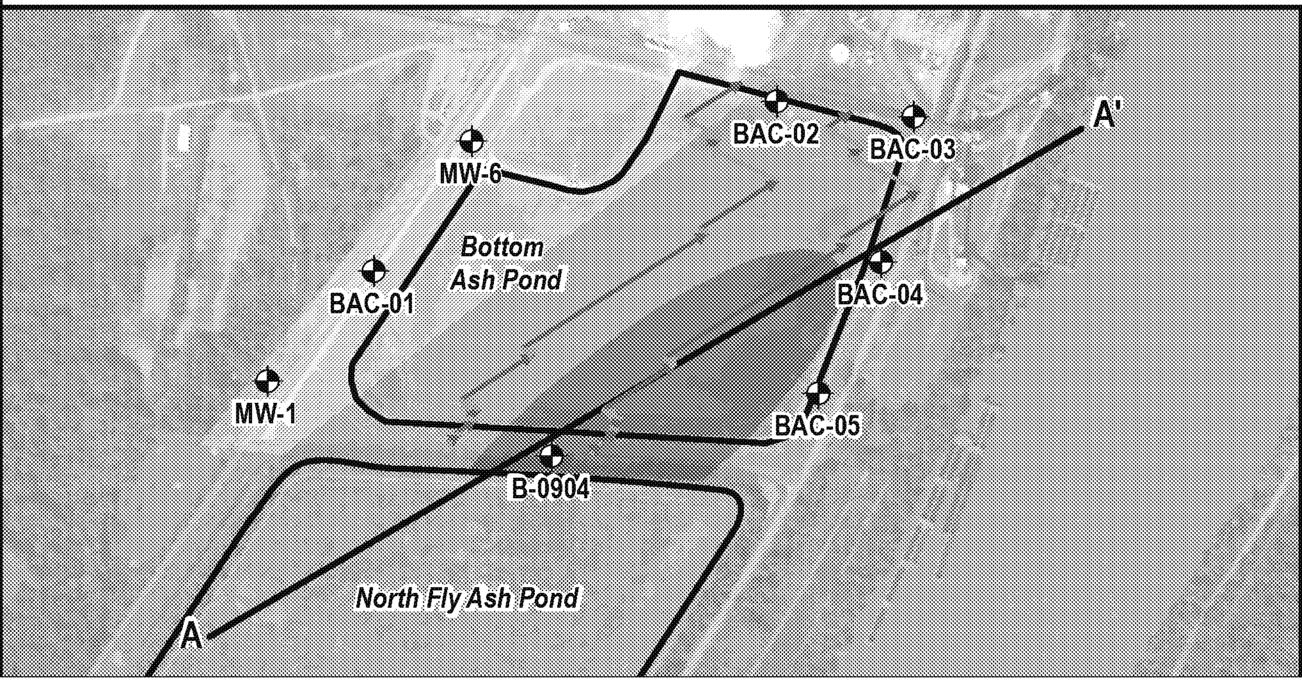

Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Vector
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca, Cl, F, SO_4, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-2: High River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

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Gavin Bottom Ash Pond

Gavin Power, LLC

2019 Annual Groundwater Monitoring and Corrective Action Report

Gavin Power Plant
Cheshire, Ohio

31 January 2020

Project No.: 0505619

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Signature Page

31 January 2020

Gavin Bottom Ash Pond

2019 Annual Groundwater Monitoring and Corrective Action Report

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CONTENTS

List of Tables

List of Attached Figures

Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal combustion residual
CFR	Code of Federal Regulations
ERM	ERM Consulting & Engineering, Inc.
Gavin	Gavin Power, LLC
Plant	General James M. Gavin Power Plant
SSI	Statistically significant increase
TDS	Total dissolved solids

EXECUTIVE SUMMARY

On behalf of Gavin Power, LLC (Gavin), ERM Consulting & Engineering, Inc. (ERM) has prepared this 2019 Annual Groundwater Monitoring and Corrective Action Report summarizing groundwater sampling activities at the Bottom Ash Pond (BAP) at the General James M. Gavin Power Plant (Plant) located in Cheshire, Ohio. The BAP is one of three regulated coal combustion residual (CCR) management units at the Plant that are subject to regulation under Title 40, Code of Federal Regulations, Part 257, Subpart D (40 CFR § 257.50 *et seq.*), also known as the CCR Rule.

This report documents the status of the groundwater monitoring program for the BAP, which includes the following as required by 40 CFR § 257.90(e):

- A summary of key actions completed;
- A description of problems encountered and actions taken to resolve the problems; and
- Identification of key activities for the coming year.

The BAP CCR unit groundwater monitoring program began 2019 in a "detection monitoring" program status as defined by 40 CFR § 257.94 and remained in detection monitoring at the end of the 2019 reporting period. Groundwater monitoring in 2019 consisted of two semi-annual monitoring events completed in March and September 2019 that included groundwater level measurements and subsequent groundwater sampling. Groundwater level measurements were used to construct updated groundwater potentiometric surface maps.

Groundwater samples were collected for laboratory analysis of CCR Rule Appendix III constituents and the results were compared to previously calculated upgradient well prediction limits to identify statistically significant increases (SSIs) for downgradient wells. The following locations and analytes exhibited SSIs in 2019:

Well	Date Sampled	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids (TDS)
BAC-02	Mar-2019	X	X	X	ϕ	X	X	X
	Sep-2019	X	X	X	ϕ	X	X	X
BAC-03	Mar-2019	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ
BAC-04	Mar-2019	X	ϕ	X	ϕ	X	X	X
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ
BAC-05	Mar-2019	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase

Each identified SSI was evaluated in the corresponding attached Alternate Source Demonstration (ASD) Report. The ASD reports identify regional background (total dissolved solids [TDS], calcium, chloride, and sulfate), mixing of upgradient groundwater and Ohio River surface water (pH), and the Kyger Creek Northern Fly Ash Pond (boron) as the sources of these SSIs; therefore, these wells remained in detection monitoring at the conclusion of 2019. Accordingly, no remedial actions were selected, initiated or performed in 2019.

1. INTRODUCTION

The General James M. Gavin Power Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River. The Plant encompasses three regulated coal combustion residual (CCR) management units that are subject to regulation under Title 40, Code of Federal Regulations, Part 257, Subpart D (40 CFR § 257.50 *et seq.*), also known as the CCR Rule: the Residual Waste Landfill (RWL), the Fly Ash Reservoir (FAR), and the Bottom Ash Pond. The BAP is south of the main Plant area and adjacent to the Ohio River (Figure 1-1). The BAP, together with the smaller Reclaim Pond, makes up the Bottom Ash Complex (BAC), which has operated since 1974. Bottom ash slurry is pumped into the BAP where the water is decanted through a reinforced concrete drop inlet structure into the Reclaim Pond. The water in the Reclaim Pond is either pumped to the Plant for reuse or discharged to the Ohio River via an overflow structure subject to Gavin's National Pollution Discharge Elimination System (NPDES) permit. The Reclaim Pond is not intended to, and does not receive any significant amount of CCR from the BAP; was not designed to hold an accumulation of CCR; and does not treat, store, or dispose of CCR. Therefore, it is not subject to the CCR Rule.

ERM Consulting & Engineering, Inc. produced this report on behalf of Gavin Power, LLC. The report documents the status of the groundwater monitoring program for the BAP, which includes the following as required by 40 CFR § 257.90(e):

- A summary of key actions completed;
- A description of problems encountered and actions taken to resolve the problems; and
- Identification of key activities for the coming year.

Consistent with the notification requirements of the CCR Rule, this annual groundwater monitoring report will be posted to the Plant operating record no later than 31 January 2020 (40 CFR § 257.105(h)(1)). Within 30 days of placing the report in the operating record, notification will be made to the Ohio Environmental Protection Agency, and the report will be placed on the Plant publicly accessible internet site (40 CFR § 257.106(h)(1), 257.107(h)(1)). Table 1-1 cross-references the reporting requirements under the CCR Rule with the contents of this report.

Table 1-1: Regulatory Requirement Cross-References

Regulatory Citation in 40 CFR Part 257, Subpart D	Requirement (paraphrased)	Where Addressed in This Report
§ 257.90(e)	Status of the groundwater monitoring program.	Section 2
§ 257.90(e)	Summarize key actions completed.	Section 2.3
§ 257.90(e)	Describe any problems encountered and actions taken to resolve problems.	Section 2.3
§ 257.90(e)	Key activities for upcoming year.	Section 4.0
§ 257.90(e)(1)	Map, aerial image, or diagram of coal combustion residual (CCR) Unit and monitoring wells.	Figures 1-1, 1-2
§ 257.90(e)(2)	Identification of new monitoring wells installed or abandoned during the preceding year and narrative description.	Not applicable—there were no new monitoring wells installed or abandoned during the preceding year.
§ 257.90(e)(3)	Summary of groundwater data, wells sampled, date sampled, and whether sample was required under detection or assessment monitoring.	Section 2.3, 3.2, Appendix C
§ 257.90(e)(4)	Narrative discussion of any transition between monitoring programs.	Section 4.0
§ 257.94(e)(2) (via § 257.90(e)(5))	Any Alternate Source Demonstration (ASD) reports and related certifications.	Appendices A–B

2. PROGRAM STATUS § 257.90(E)

2.1 Monitoring Well Network

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05). All of the monitoring wells are screened in the uppermost aquifer around the BAP. The uppermost aquifer is approximately 25 feet to 35 feet thick and consists of fine to coarse sand; it is located below an approximately 20-foot thick confining layer of silty clay with interbedded sand and silt, and above a shale bedrock unit.

Figure 2-1 provides the monitoring well locations on the site location map. No new wells were installed or decommissioned after certification of the well network by Geosyntec in 2016 (Geosyntec 2016).

2.2 Previous Groundwater Monitoring Activities

The BAP monitoring wells were initially sampled eight times between August 2016 and July 2017 to establish upgradient well baseline data. Consistent with the CCR Rule and the Groundwater Monitoring Plan Appendix G Statistical Analysis Plan (ERM 2017), ERM established a prediction limit approach to identify potential future impacts to groundwater. After subsequent groundwater sampling events in July 2017 and May and September 2018, ERM compared the prediction limits to the results from the downgradient wells to identify statistically significant increases. ERM developed Alternate Source Demonstration Reports for each sampling event discussing each SSI. Each ASD report concluded that SSIs resulted from alternate sources, and thus the CCR unit remained in detection monitoring (ERM 2018b; ERM 2018c; ERM 2019b). Table 2-1 below summarizes the SSIs which were identified in the 2017 and 2018 Annual Groundwater Monitoring and Corrective Action Reports (ERM 2018a; ERM 2019a).

Table 2-1: Previous SSIs for Downgradient Wells

Well	Date Sampled	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids (TDS)
BAC-02	Jul-2017	X	X	X	ϕ	X	X	X
	May-2018	X	X	X	ϕ	X	X	X
	Sep-2018	X	X	X	X	X	X	X
BAC-03	Jul-2017	X	ϕ	X	ϕ	X	X	ϕ
	May-2018	X	ϕ	X	ϕ	X	X	X
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ
BAC-04	Jul-2017	X	ϕ	X	ϕ	X	X	X
	May-2018	X	ϕ	X	ϕ	X	X	X
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ
BAC-05	Jul-2017	X	ϕ	ϕ	X	X	X	ϕ
	May-2018	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase

2.3 2019 Sampling Summary

BAP groundwater monitoring for 2019 was performed under the detection monitoring program, and each of the seven monitoring wells was sampled in March and September 2019 for the 40 CFR Part 257, Subpart D, Appendix III analytes. Table 2-2 provides a summary of the 2019 sample dates and the well gradient designation (upgradient or downgradient) from the CCR unit.

Table 2-2: Sampling Dates for Each Well

Well	Location	Sampling Date			
		16 Mar 2019	17 Sep 2019	18 Sep 2019	19 Sep 2019
BAC-01	Upgradient	X			X
BAC-02	Downgradient	X		X	
BAC-03	Downgradient	X			X
BAC-04	Downgradient	X		X	
BAC-05	Downgradient	X		X	
MW-1	Upgradient	X	X		
MW-6	Upgradient	X		X	

During the March and September sampling events, no significant field problems were encountered and no actions were therefore required to resolve problems.

2.4 Data Quality

ERM reviewed field and laboratory documentation to assess the validity, reliability, and usability of the analytical results. Samples collected in 2019 were analyzed by TestAmerica of North Canton, Ohio. Data quality information reviewed for these results included field sampling forms, chain-of-custody documentation, holding times, laboratory methods, laboratory method blanks, laboratory control sample recoveries, field duplicate samples, matrix spikes/matrix spike duplicates, quantitation limits, and equipment blanks. Data qualifiers were appended to results in the project database as appropriate based on laboratory quality measurements (e.g., control sample recoveries) and field quality measurements (e.g., agreement between normal and field duplicate samples). The data quality review found the laboratory analytical results to be valid, reliable, and usable for decision-making purposes with the listed qualifiers. No analytical results were rejected.

3. 2019 RESULTS

3.1 2019 Groundwater Flow Direction and Velocity

Gavin personnel measured depth to groundwater at each monitoring well prior to each sampling event. Groundwater elevations, calculated by subtracting the depth to groundwater from the surveyed reference elevation for each well, were established for each sampling event. Potentiometric surface maps for March and September 2019 are presented on Figure 3-1 and Figure 3-2, respectively.

The hydraulic gradient for the March 2019 sampling event was generally southeast, while the hydraulic gradient for the September 2019 sampling event was generally northeast, with both gradients toward the Ohio River. Based on records from the U.S. Geological Survey gauging station at Point Pleasant, West Virginia, the depth to groundwater in March 2019 was measured within one week after a period of flooding in the Ohio River. Depth to groundwater in September 2019 was measured during a period without flood activity and the northeasterly groundwater flow direction (i.e., down river) observed in September 2019 is consistent with the flow directions observed previously during times of lower river stage. The southeastern flow orientation during March 2019 is likely associated with floodplain recovery during flood recession.

Measured hydraulic gradients were 0.0008 and 0.0013 in the March and September 2019 sampling events, respectively. Based on the measured hydraulic gradients, an assumed porosity of 0.3, an estimated hydraulic conductivity of 0.5 centimeters per second based on the particle-size distribution of the sandy alluvium (Freeze and Cherry 1979), the velocity of groundwater in the alluvial aquifer beneath the BAP varied between 1,400 and 2,200 feet per year when the groundwater elevation data were collected.

3.2 Comparison of Results to Prediction Limits

Consistent with the CCR Rule and the Statistical Analysis Plan (ERM 2017) in the operating record, a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits were developed for the Appendix III parameters; in the case of pH, a lower prediction limit was also developed. The 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a) provides documentation of the development of the upper and lower prediction limits for the BAP.

3.2.1 March 2019 Results

Table 3-1 summarizes a comparison of the March 2019 results to the identified SSIs based on prediction limits for Appendix III analytes in the downgradient wells.

Table 3-1: SSIs from March 2019 Sampling Event

Analyte	Monitoring Well			
	BAC-02	BAC-03	BAC-04	BAC-05
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
TDS	X	ϕ	X	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase; TDS = total dissolved solids
Results are for the downgradient wells sampled in March 2019.

March 2019 SSIs were similar to those observed in 2018. Alternate sources were similarly identified for each of the SSIs detected in the March 2019 data and documented in the Gavin BAP First Semiannual Sampling Event of 2019 ASD Report (ERM 2019c). This ASD Report identified the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. The report also identified regional discharge of groundwater as the source of calcium, chloride, sulfate, and total dissolved solids (TDS), and the Kyger Creek Northern Fly Ash Pond as the source of boron. A copy of the Gavin BAP First Semiannual Sampling Event of 2019 ASD Report is included in Appendix A (ERM 2019c).

3.2.2 September 2019 Results

Table 3-2 summarizes a comparison of the September 2019 results to the identified SSIs based on prediction limits for Appendix III analytes in the downgradient wells.

Table 3-2: SSIs from September 2019 Sampling Event

Analyte	Monitoring Well			
	BAC-02	BAC-03	BAC-04	BAC-05
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
TDS	X	ϕ	ϕ	ϕ

Notes: ϕ = No SSI, X = SSI; SSI = statistically significant increase; TDS = total dissolved solids
Results are for the downgradient wells sampled in September 2019.

September 2019 SSIs were similar to those observed in 2018 and March 2019. Alternate sources were identified for each of the SSIs associated with the September 2019 data and documented in the Gavin BAP Second Semiannual Sampling Event of 2019 ASD Report (ERM 2020). This ASD Report identified the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. The report also identified the regional discharge of groundwater as the source of calcium, chloride, sulfate, and TDS, and the Kyger Creek Northern Fly Ash

Pond as the source of boron. A copy of the Gavin BAP Second Semiannual Sampling Event of 2019 ASD Report is included in Appendix B (ERM 2020).

The BAC Second Semiannual Sampling Event of 2018 ASD Report (ERM 2019b) was submitted as Appendix C of the 2018 annual sampling report in January 2019 (ERM 2019a).

Appendix C provides a summary of all historical and current analytical results obtained from the BAP groundwater monitoring program.

4. KEY FUTURE ACTIVITIES

The five ASD Reports prepared to date concluded that sources other than the BAP were responsible for the identified SSIs. As required by 40 CFR § 257.94(e)(2), these demonstrations were completed within 90 days of detecting the SSIs and were certified by a qualified professional engineer. Because it met these requirements, the BAP remains in detection monitoring at the conclusion of 2019. Two semi-annual groundwater sampling events will be performed at the BAP in 2020, and the results will be compared to the prediction limits to identify potential SSIs.

Gavin plans to install one or two additional monitoring wells in 2020 on the southern boundary of the BAP, between the BAP and the Kyger Creek North Fly Ash Pond.

5. REFERENCES

ERM (ERM Consulting & Engineering, Inc.). 2017. *Groundwater Monitoring Plan. Bottom Ash Complex, Fly Ash Reservoir, and Residual Waste Landfill, Gavin Plant, Cheshire Ohio*.

ERM. 2018a. *2017 Annual Groundwater Monitoring and Corrective Action Report. Bottom Ash Complex, Gavin Plant, Cheshire Ohio,* dated 1-31-2018.

ERM. 2018b. *Gavin Bottom Ash Complex Alternate Source Demonstration,* dated 7-3-2018.

ERM. 2018c. *First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration. Bottom Ash Complex,* dated 10-12-2018.

ERM. 2019a. *2018 Annual Groundwater Monitoring and Corrective Action Report. Bottom Ash Complex, Gavin Plant, Cheshire Ohio,* dated 1-31-2019.

ERM. 2019b. *Gavin Bottom Ash Complex Second Semiannual Sampling Event of 2018 Alternate Source Demonstration Report*, dated 1-31-2019.

ERM. 2019c. *Gavin Bottom Ash Pond First Semiannual Sampling Event of 2019 Alternate Source Demonstration Report,* dated 11-4-2019.

ERM. 2020*. Gavin Bottom Ash Pond Second Semiannual Sampling Event of 2019 Alternate Source Demonstration Report,* dated 1-31-2020.

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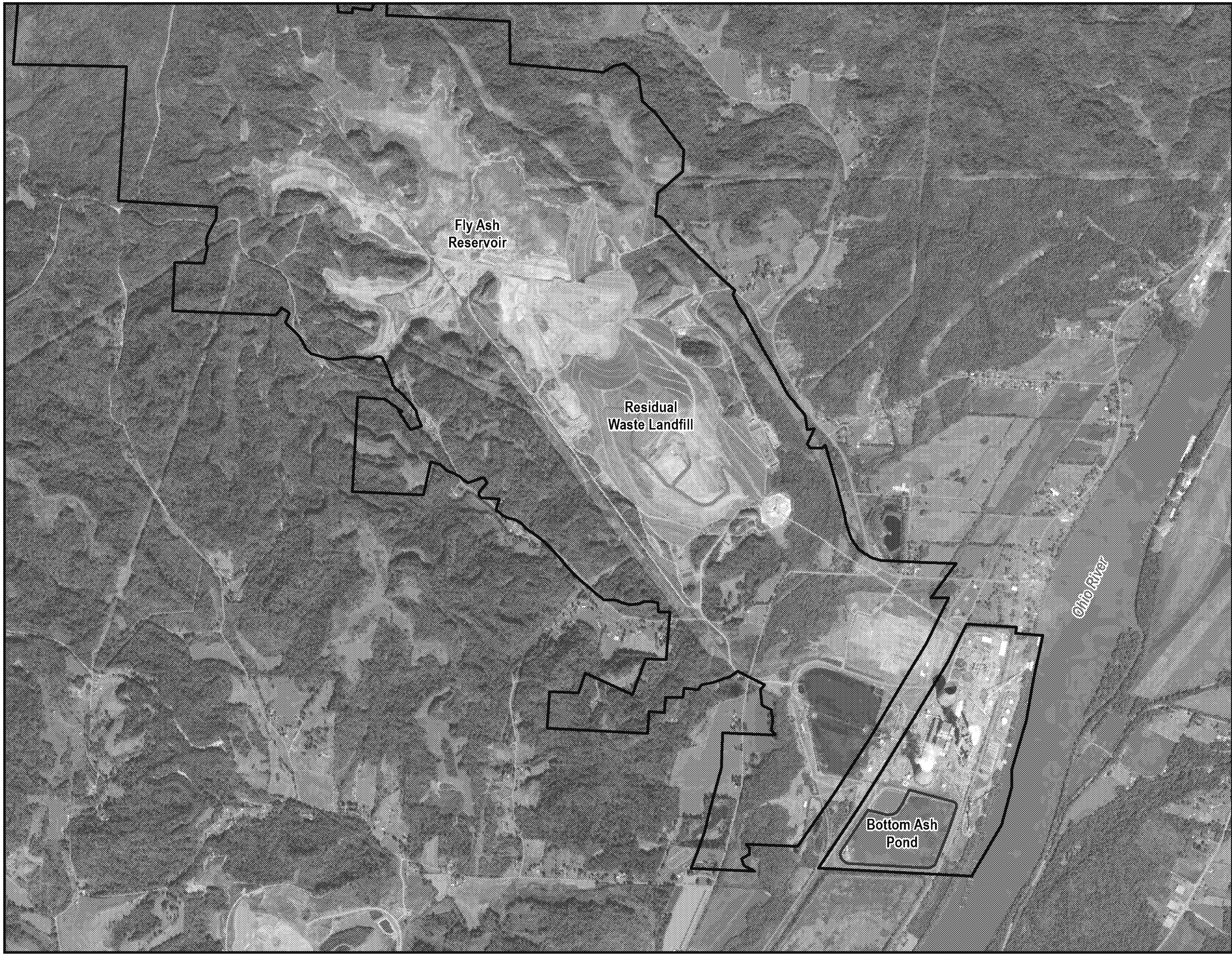
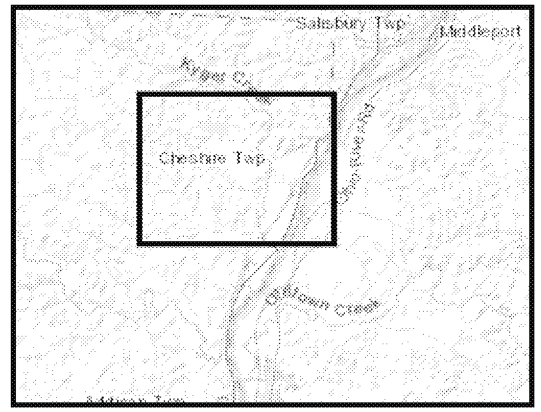
Geosyntec. 2016. *Groundwater Monitoring Network Evaluation, Gavin Site—Bottom Ash Complex, Cheshire, Ohio.*

FIGURES





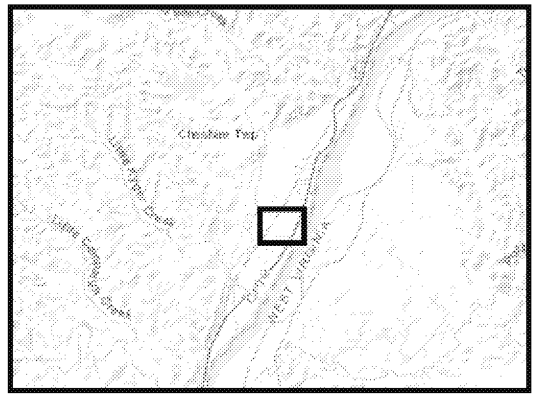
Legend

- Bottom Ash Pond
- Gavin Property Boundary

0 500 1,000 2,000 3,000 4,000
Feet

Figure 1-1: Bottom Ash Pond Location
Gavin Power Plant
Cheshire, Ohio

ERM



Legend

- Federal Sampling Program Groundwater Monitoring Well
- Approximate location of Bottom Ash Pond boundary
- Property Boundary

NOTES:

1. Locations are approximate
2. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.4

N

0 62.5 125 250 375 500
Feet

Figure 2-1: Monitoring Well Network
Gavin Power Plant
Cheshire, Ohio

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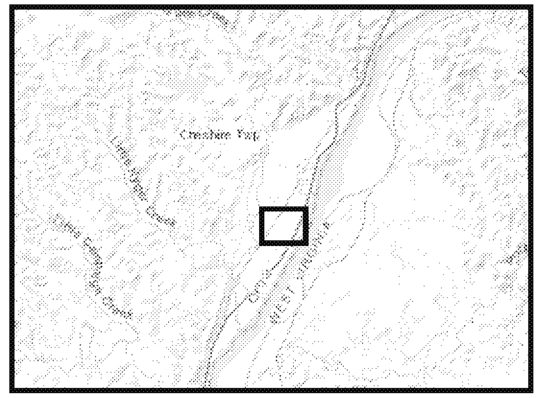

Legend

- Federal Sampling Program Groundwater Monitoring Well
- 539.85 Groundwater Elevation (ft)
- Interpreted Groundwater Elevation Contour
- Interpreted Groundwater Flow Direction

NOTES:
1. Locations are approximate
2. Groundwater elevations based on measurements made on 3/5/2019
3. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.5

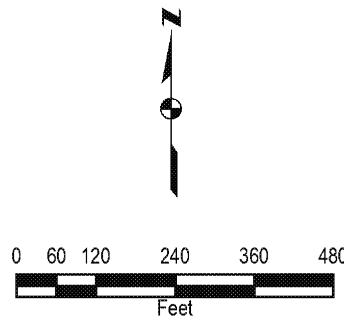

Figure 3-1: Interpreted Groundwater Potentiometric Contour
March 2019
Gavin Power Plant
Cheshire, Ohio

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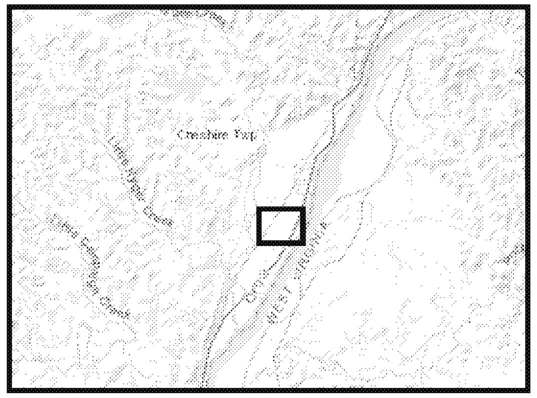

Legend

Federal Sampling Program Groundwater Monitoring Well

539.85 Groundwater Elevation (ft)

Interpreted Groundwater Elevation Contour

Interpreted Groundwater Flow Direction

NOTES:

1. Locations are approximate
2. Groundwater elevations based on measurements made on 9/5/2019
3. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.5

N

0 60 120 240 360 480

Feet

Figure 3-2: Interpreted Groundwater Potentiometric Contour September 2019

Gavin Power Plant

Cheshire, Ohio

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APPENDIX A GAVIN BOTTOM ASH POND FIRST SEMIANNUAL SAMPLING EVENT OF 2019 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Bottom Ash Pond

Gavin Power, LLC

First Semiannual Sampling Event of 2019 Alternate Source Demonstration Report

Gavin Power Plant
Cheshire, Ohio

04 November 2019

Project No.: 0505619

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CONTENTS

List of Figures

Acronyms and Abbreviations

ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCR Rule	Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments
CCR Unit	Bottom Ash Complex CCR Surface Impoundment
CFR	Code of Federal Regulations
Gavin	Gavin Power, LLC
mg/L	milligrams per liter
NFAP	Kyger Creek North Fly Ash Pond
OEPA	Ohio Environmental Protection Agency
Plant	General James M. Gavin Power Plant
SFAP	Kyger Creek South Fly Ash Pond
SSI	statistically significant increase
TDS	Total Dissolved Solids
USEPA	United States Environmental Protection Agency
USEPA Guidance	Solid Waste Disposal Facility Criteria Technical Manual, USEPA 530-R-93-017
USGS	United States Geological Survey

1. INTRODUCTION

1.1 Regulatory and Legal Framework

In accordance with 40 Code of Federal Regulations (CFR) Part 257 Subpart D—Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments ("CCR Rule"), Gavin Power, LLC ("Gavin") has been implementing the groundwater monitoring requirements of 40 CFR § 257.90 *et seq.* for its Bottom Ash Pond (BAP) CCR Surface Impoundment (the "CCR Unit") at the General James M. Gavin Power Plant (the "Plant"). Gavin calculated background levels and conducted statistical analyses for Appendix III constituents in accordance with 40 CFR § 257.93(h). Currently, Gavin is performing detection monitoring at the BAP in accordance with 40 CFR § 257.94. Statistically Significant Increases (SSIs) over background concentrations were detected in downgradient monitoring wells for Appendix III constituents for the first semiannual groundwater sampling event of 2019 and are explained in this Report.

An SSI for one or more Appendix III constituents is a potential indication of a release of constituents from the CCR unit to groundwater. In the event of an SSI, the CCR Rule provides that "the owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality" (40 CFR § 257.94(e)(2)). If it can be demonstrated that the SSI is due to a source other than the CCR unit, then the CCR unit may remain in the Detection Monitoring Program instead of transitioning to an Assessment Monitoring Program. An Alternate Source Demonstration (ASD) must be made in writing, and the accuracy of the information must be verified through certification by a qualified Professional Engineer (40 CFR § 257.94(e)(2)).

The guidance document, "Solid Waste Disposal Facility Criteria Technical Manual, USEPA 530-R-93-017, Subpart E" (Nov. 1993) ("USEPA Guidance"), lays out the following six lines of evidence that should be addressed to determine whether an SSI resulted from a source other than the regulated disposal unit:

1. An alternative source exists.
2. Hydraulic connection exists between the alternative source and the well with the significant increase.
3. Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the unit.
4. The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the unit when the fate and transport characteristics of the constituents are considered.
5. The concentration observed in ground water could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and site hydrogeologic conditions.
6. The data supporting conclusions regarding the alternative source are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

This ASD Report addresses each of these lines of evidence for the SSIs detected in the groundwater beneath the BAP.

1.2 Background

The Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River (Figure 1-1). The BAP is one of three CCR units at the Plant that are subject to regulation under the

CCR Rule and is located adjacent to and immediately south of the main Plant area along the Ohio River (Figure 1-2). Adjacent to the BAP is the smaller Reclaim Pond (Figure 1-3).

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) positioned around the perimeter of the BAP (Figure 1-3). In addition, monitoring well B-0904 is located to the south of the BAP and is used in this report to evaluate the quality of groundwater migrating from the Kyger Creek North Fly Ash Pond (NFAP) under the BAP. All of the monitoring wells associated with these units are screened in the uppermost aquifer beneath the BAP. The uppermost aquifer has the following characteristics (Geosyntec 2016):

- Consists of fine to coarse sand with some gravel that gets progressively finer with decreasing depth;
- Approximately 25 feet to 35 feet thick; and
- Located below an approximately 20-foot-thick silty clay confining layer, and above a shale bedrock unit.

The 2017 Annual Groundwater Monitoring and Corrective Action Report was prepared to document the status of the groundwater monitoring program for the BAP (ERM 2018a), and included results from eight rounds of sampling performed from August 2016 to August 2017. The report compared upper and lower prediction limits to the most recent results from the downgradient wells. Also, the following reports were previously prepared and posted to Gavin's public website to identify alternate sources for the following:

- SSIs associated with the August 2016 to August 2017 period were addressed in the Gavin BAC ASD Report (ERM 2018b).
- SSIs associated with the May 2018 sampling event were addressed in the *Gavin BAC First Semiannual Sampling Event of 2018 ASD Report* (ERM 2018c)
- SSIs associated with the September 2018 sampling event were addressed in the *Gavin BAC Second Semiannual Sampling Event of 2018 ASD Report* (ERM 2018d)

Results from the first semiannual groundwater sampling event of 2019, which was performed in March 2019, were compared to the upper and lower prediction limits, and SSIs for Appendix III analytes from this sampling event are summarized in Table 1-1.

Table 1-1: SSIs in Groundwater beneath the BAC

Analyte	BAC-02	BAC-03	BAC-04	BAC-05
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
Total Dissolved Solids	X	ϕ	X	ϕ
Notes: ϕ = No SSI, X = SSI				
Results are for the downgradient wells sampled in March 2019.				

Consistent with the previous ASD Reports, this ASD Report identifies the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River; regional discharge of groundwater as the source of calcium, chloride, sulfate, and total dissolved solids (TDS); and the Kyger Creek NFAP as the source of boron. Supporting information and additional discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this report.

2. DESCRIPTION OF ALTERNATE SOURCES

The first ASD Report for the BAP (ERM 2018b) identified and described in detail three alternate sources for the Appendix III constituents: the Ohio River, the regional geology, and the neighboring Kyger Creek Generating Station. A summary of each of these alternate sources is provided below.

2.1 Ohio River

The Ohio River extends approximately 981 river miles from Pittsburgh, Pennsylvania to Cairo, Illinois, and drains an area of approximately 205,000 square miles (ORSANCO 2018). The Ohio River is approximately 700 feet east of the BAP and the alluvial aquifer beneath the BAP is hydraulically connected to the river. When the Ohio River floods, water from the river mixes with groundwater within the alluvial aquifer (ERM 2018b). The mixing of groundwater and river water is discussed in Section 3, and the quality of the Ohio River water that mixes with groundwater is discussed in Section 4.

2.2 Regional Background

The regional bedrock geology near the Plant includes Pennsylvanian-age sedimentary rocks from the Monongahela and Conemaugh Groups. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). Overlying the Pennsylvanian-age rocks are Quaternary-age alluvium that consists primarily of sand, silt, clay, and gravel (OEPA 2018). The sedimentary rocks form the ridges and valleys west of the Ohio River, and the unconsolidated sand, silt, clay, and gravel are located along the Ohio River and tributaries. The consolidated sedimentary rocks and the unconsolidated alluvium form the two major aquifers near the Plant (Figure 2-1). The interaction of groundwater with rocks and minerals within these aquifers can influence the concentration of Appendix III constituents (ORSANCO 1984).

Naturally-occurring brine, which is known to be rich in calcium, chloride, sulfate, fluoride and other trace elements, exists in the subsurface in the Ohio River Valley (Geological Survey of Ohio 1932; ORSANCO 1984; ODNR 1995). Some of the brines also exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles southwest of the Plant in Gallipolis, Ohio, and was utilized for the commercial production of salt starting in 1807 (Geological Survey of Ohio 1932). Naturally occurring brine was also identified at the land surface in Jackson, Ohio, approximately 30 miles west of the Plant (ODNR 1995). The regional presence of shallow brine indicates the potential for naturally occurring brine to contribute Appendix III constituents to groundwater at the Plant.

To account for natural and anthropogenic influences on Appendix III constituents on a regional scale, background groundwater data were obtained from United States Geological Survey (USGS) databases. The background groundwater data set is discussed further in Section 4.

2.3 Kyger Creek Generating Station

The Kyger Creek Generating Station is located along the Ohio River in Gallia County, south of the Plant (Figure 2-2). The Kyger Creek fly ash pond complex consists of the 110-acre NFAP and 60-acre South Fly Ash Pond (SFAP). The construction history and groundwater monitoring results of these ponds are summarized in the first ASD Report (ERM 2018b). The NFAP is located less than 300 feet from the BAP, and the units share an approximately 2,000-foot-long border (Figure 2-2). The NFAP has a higher potential to impact groundwater than the BAP because the NFAP contains fly ash, which, when compared to bottom ash, has a greater tendency to leach CCR constituents (Cox et al. 1978; Jones et al. 2012). This is described further in Section 7.

3. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

Detailed explanations of the hydraulic connections between the alternate sources and the downgradient wells of the BAC were previously provided in the first ASD Report for the BAP (ERM 2018b). A summary of each of these connections is provided below.

3.1 Ohio River

Both the Gavin BAP and the Kyger Creek NFAP are located above the alluvial aquifer (Geosyntec 2016; AGES 2016; ERM 2018b). Groundwater in the alluvial aquifer typically flows from the vicinity of the BAP and NFAP toward the Ohio River (ERM 2018b). Exceptions to this flow direction occur when the river stage (elevation of the surface water in the river) exceeds approximately 540 feet above mean sea level (ERM 2018b). When this occurs, groundwater flow reverses and flows generally westward from the Ohio River toward the BAP and NFAP (ERM 2018b). The correlation of the flow reversals with Ohio River flooding is strong evidence that the alluvial aquifer is hydraulically connected to the Ohio River (ERM 2018b).

3.2 Regional Background

Regional groundwater within the fractured sedimentary bedrock flows from northwest to southeast toward the Ohio River. Precipitation that falls in areas of higher topographic elevation northwest of the Plant infiltrates the land surface and recharges the underlying aquifers. Groundwater then flows from areas of higher hydraulic head (i.e., high topographic elevation) to areas of lower hydraulic head (i.e., low topographic elevation). As groundwater flows from northwest to southeast, it migrates both horizontally and vertically through the fracture network within the sedimentary bedrock. Near the Plant, groundwater in the bedrock aquifer mixes with groundwater in the alluvial aquifer, which then discharges to the Ohio River (Figure 3-1). Thus, regional groundwater is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b).

3.3 Kyger Creek Generating Station

The Ohio River stage elevation records were used to identify the frequency and duration of flow reversals, and were combined with the groundwater velocity estimates to develop groundwater flow paths under the BAP (ERM 2018b). There are three key points associated with the interpreted groundwater flow paths:

- The Kyger Creek NFAP is hydraulically upgradient of the four monitoring wells (BAC-02, BAC-03, BAC-04 and BAC-05) that are downgradient of the Gavin BAP.
- Due to the northeast flow direction, the Kyger Creek NFAP is not upgradient of the western edge of the BAP, where upgradient monitoring wells MW-1, BAC-01, and MW-6 are located.
- State monitoring well B-0904 is directly downgradient of the NFAP and upgradient of the BAP.

Based on the presence of the same alluvial aquifer beneath both the Kyger Creek NFAP and the Gavin BAP, and the average north-eastern direction of groundwater flow, it is evident that the Kyger Creek NFAP is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b).

4. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG THE FLOW PATHWAYS

4.1 Ohio River

The pH of the Ohio River is near neutral and the pH of groundwater emanating from the Kyger Creek NFAP is slightly acidic (ERM 2018b). As described in Section 3, the hydrogeologic data indicate that water from the Ohio River mixes with groundwater from the alluvium underlying the BAP. When these waters mix under the BAP, the result is an intermediate pH (i.e., between the pH of the Ohio River and the pH of the NFAP). This pattern was observed in the March 2019 data, as summarized in Table 4-1 and on Figure 4-1.

Table 4-1: Groundwater and Surface Water pH Values

Location	pH
Kyger Creek NFAP Groundwater (B-0904, March 2019)	5.22
BAP Downgradient Groundwater (BAC-02 through BAC-05, March 2019)	6.10–6.46
Ohio River (March 2019)	7.58

The March 2019 results remain consistent with the 2017 results presented in the first ASD Report for the BAP (ERM, 2018b) and the results presented in the 2018 ASD reports (ERM 2018c and 2018d). These results demonstrate the pH of the Ohio River water is higher than Kyger Creek groundwater and the mixing of these waters results in the intermediate pH observed in groundwater downgradient of the BAP.

4.2 Regional Background

Regional background groundwater quality data were obtained from the USGS National Water Information System database. Groundwater results were selected for monitoring wells constructed within the alluvial, Conemaugh Group, and Monongahela Group aquifers located within 50 miles of the Plant (Figure 4-2). The USGS background data were compared to downgradient BAP data (wells BAC-02, BAC-03, BAC-04, and BAC-05) and Ohio River data collected in March 2019. As shown in Table 4-2, the concentrations of calcium, chloride, fluoride, sulfate, and TDS in groundwater downgradient of the BAP are between the concentrations in USGS background groundwater and the Ohio River. These results are consistent with previous ASD reports for the BAP (ERM 2018b, 2018c, 2018d) and demonstrate that calcium, chloride, fluoride, sulfate, and TDS are present along flow pathways from the sedimentary bedrock aquifers to the alluvial aquifer beneath the BAP.

Table 4-2: Comparison of USGS Regional Background to BAP and Ohio River

Analyte	Units	USGS Background (Max)	Downgradient BAP[a]	Ohio River[a]
Calcium	mg/L	520	70–150	36
Chloride	mg/L	9,900	37–96	28
Fluoride	mg/L	8.8	0.078–0.15	0.12
Sulfate	mg/L	2,700	200–370	68
TDS	mg/L	9,910	470–920	200

[a] *Results from samples collected in March 2019*
mg/L = milligrams per liter

4.3 Kyger Creek Generating Station

The concentration of boron in groundwater downgradient of the BAP (Figure 4-3) ranges from 2.20 milligrams per liter (mg/L) to 2.90 mg/L in the March 2019 samples. Figure 4-3 shows the distribution of boron at the northern boundary of the Kyger Creek NFAP and along the flow pathways as summarized below:

- The highest boron concentrations were measured in wells B-0904, BAC-05, and BAC-04, which are located closest to and downgradient of the Kyger Creek NFAP. Notably, monitoring well B-0904 is upgradient of the BAP.
- Concentrations decrease with distance downgradient from the NFAP along the northeastern flow path.

In addition to the Ohio Environmental Protection Agency (OEPA) correspondence that concluded that groundwater below the NFAP appears to be impacted by a release from the NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]), the SFAP data also suggest boron is present in groundwater below both Kyger Creek fly ash ponds. Boron analytical results from eight rounds of groundwater sampling conducted between October 2015 and September 2017 at SFAP downgradient monitoring wells (AEG 2018) are summarized in Table 4-3.

Table 4-3: Kyger Creek SFAP Boron Results

Analyte	Units	Maximum	Average
Boron	mg/L	17.7	6.8

The average concentration of boron (6.8 mg/L) in the SFAP is higher than the highest concentration of boron measured in groundwater beneath the BAP (2.9 mg/L) in March 2019. The SFAP and the NFAP both manage fly ash generated at the Kyger Creek Generating Station so it is reasonable to expect that the chemical characteristics of the landfilled fly ash are similar in both units. Given the elevated boron concentrations in groundwater downgradient of the SFAP, and considering that both units are unlined, elevated concentrations of boron in groundwater downgradient of the Kyger Creek NFAP are expected. Thus, this evidence demonstrates that boron is present at the Kyger Creek Generating Station.

5. LINKAGES OF CONSTITUENT CONCENTRATIONS AND DISTRIBUTIONS BETWEEN ALTERNATE SOURCES AND DOWNGRADIENT WELLS

5.1 Ohio River

As described in Section 3 and in detail in the first ASD Report for the BAP (ERM 2018b), the groundwater elevation and flow directions provide strong evidence of groundwater flow reversals and the mixing of Ohio River surface water and groundwater. The intermediate pH of groundwater downgradient of the BAP (i.e., the value between the pH of Kyger Creek groundwater and the pH of the Ohio River) is consistent with the mixing of surface water and groundwater. This evidence shows there is a linkage between groundwater downgradient of the BAP and the Ohio River.

5.2 Regional Background

As described in Section 3.2 and illustrated on Figure 3-1, groundwater flowing in the sedimentary bedrock aquifers discharges to the alluvial aquifer along the Ohio River, including the portion beneath the BAP. As described in Section 4.2, regional concentrations of calcium, chloride, fluoride, sulfate, and TDS are higher than respective groundwater concentrations downgradient of the BAP. Based on these observations, it is likely that the discharge of groundwater from the sedimentary bedrock aquifers to the alluvial aquifer under the BAP (Figure 5-1 and Figure 5-2) is an alternate source for these constituents. This evidence shows that there is a linkage between groundwater downgradient of the BAP and regional background.

5.3 Kyger Creek Generating Station

When the river stage is low (Figure 5-1), groundwater in the alluvial aquifer moves in a north-easterly direction from the NFAP, under the BAP, and eventually discharges to the Ohio River. During times of higher river stage (Figure 5-2), groundwater in the alluvial aquifer temporarily reverses direction and river water flows into the alluvial aquifer. Despite the temporary reversals of groundwater flow caused by flooding of the Ohio River, the overall, long-term flow direction is to the northeast, indicating that the source of boron detected in the monitoring wells downgradient of the BAP is the Kyger Creek NFAP.

6. RELEASES FROM THE BAP ARE NOT SUPPORTED AS THE SOURCES

6.1 Chemical Fingerprints

The geochemical fingerprints of surface water from the BAP, groundwater from the BAP, groundwater from the NFAP, and surface water from the Ohio River were determined using a piper diagram. The piper diagram is a graphical procedure commonly used to interpret sources of dissolved constituents in water, and evaluate the potential for mixing of waters from different sources (Piper 1944). The samples presented on the diagram were collected from 2012 through 2019. The primary observations and conclusions based on the BAP piper diagram (Figure 6-1) are the following:

- Multiple samples collected from a single location (e.g., the Ohio River, or well B-0904) tended to be tightly clustered, which indicates the chemical signatures of individual locations were consistent over time.
- Groundwater from BAP upgradient wells MW-1, BAC-01, and MW-6 has a unique geochemical signature dominated by calcium and bicarbonate. This groundwater flows under the west-northwest portion of the BAP and does not appear to be influenced by the Ohio River or Kyger Creek NFAP.
- Groundwater from well B-0904, which is downgradient of the Kyger Creek NFAP and upgradient of the BAP, is dominated by calcium and sulfate, and has a signature that is distinct from all other chemical signatures on the diagram.
- Surface water from the Ohio River also has a distinct signature that plots closer to the center of the piper diagram.
- Groundwater from BAP downgradient wells BAC-02, BAC-03, BAC-04, and BAC-05 plots between the Ohio River and NFAP groundwater, which is an independent line of evidence that groundwater under a majority of the BAP is a mixture of groundwater from the NFAP (represented by well B-0904, which is upgradient of the BAP) and the Ohio River.

Thus, the chemical fingerprints of the waters at issue indicate that the BAP is not the source of the SSIs.

7. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

7.1 Ohio River

The hydraulic connection of the Ohio River to the alluvial aquifer was established after the last deglaciation (USGS 2004). Seasonal flooding of the Ohio River, which has occurred regularly over the period that the Plant has existed, is the driving force behind the mixing of surface water and groundwater. Thus, source data for the Ohio River are historically consistent with hydrogeologic conditions and findings of the monitoring program.

7.2 Regional Background

This report provides background groundwater quality data for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the Plant. The patterns of regional groundwater flow through fractured bedrock near the BAP were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). Assuming a conservatively high effective porosity of 1 percent results in an estimated groundwater velocity for the Morgantown Sandstone and Cow Run Sandstone of 50 feet per year and 80 feet per year (ERM 2019a), respectively, which would allow ample time for groundwater to migrate from upgradient regional sources onto Plant property since the end of the last glaciation. The data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

7.3 Kyger Creek Generating Station

The Kyger Creek NFAP was constructed in 1955 with its base on native soil, without an engineered liner to contain leachate. The unit was used to manage fly ash until it was drained and closed in 1997, although dewatered ash is still present within the NFAP. Groundwater flows under the NFAP in a northeasterly direction toward and under the Gavin BAP. Given the six decades that this unit has contained fly ash, and the alluvial aquifer groundwater velocity estimates of 1300 to 1800 feet per year (ERM 2019b), ample time has passed for groundwater to migrate from the Kyger Creek NFAP beneath the BAP. The following evidence supports the NFAP as the alternate source of boron:

- The distribution of boron in groundwater beneath the BAP (Section 4);
- Analytical results from groundwater samples collected below the Kyger Creek SFAP suggest boron is present in Kyger Creek groundwater, and given the similarity in construction and types of CCR managed, it is reasonable to interpret SFAP groundwater data as representative of NFAP groundwater quality (Section 4);
- The chemical fingerprinting evidence shows groundwater from Kyger Creek mixes with Ohio River water under the BAP (Section 6);
- The OEPA concluded that groundwater appears to be impacted by a release from the NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]).

In addition, a comparison of the materials managed provides evidence that the BAP is not the source, and the NFAP is a more likely source of boron. The NFAP has contained fly ash since 1955, while the BAP has been used primarily for the management of bottom ash since 1974. Bottom ash and fly ash have different physical and chemical properties, and laboratory investigations have shown elements (including Appendix III constituents) have a much greater potential to leach from fly ash compared to bottom ash (Cox et al. 1978; Jones et al. 2012). The higher concentrations of boron observed in Kyger Creek SFAP groundwater compared to the lower concentration of boron observed in groundwater downgradient of the BAP are consistent with the known leaching properties of fly ash and bottom ash, and would therefore be more likely to leach from the SFAP than the BAP based on the historical use of each unit. These observations support the conclusion that the NFAP, and not the BAP, is the source of boron in groundwater under the BAP. Thus, the data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

8. CONCLUSIONS

The SSIs identified in this report for samples from monitoring wells downgradient of the BAP were detected in March 2019. The data were reviewed for quality assurance, and reported to Gavin on 07 August 2019. In response to the SSIs, this ASD Report was prepared within the required 90-day period in accordance with 40 CFR § 257.94(e)(2).

All SSIs in the downgradient BAP monitoring wells have been determined to result from alternate sources: mixing with the Ohio River, regional groundwater discharge, and the Kyger Creek Power Plant. Table 8-1 summarizes the six lines of evidence for each of the SSIs:

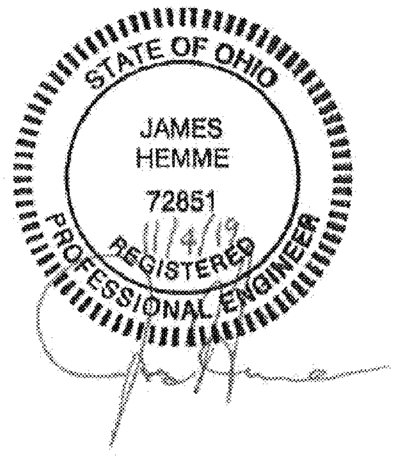
Table 8-1: BAP ASD Summary

Analyte	SSI Location	Six Lines of Evidence from USEPA Guidance					
		Alternate Source	Hydraulic Connection	Constituent Present at Source or Along Flow Path	Constituent Distribution More Strongly Linked to Alternate Source	Constituent Could Not Have Resulted from the BAP	Data Are Historically Consistent with Hydrogeologic Conditions
Boron	BAC-02 BAC-03 BAC-04 BAC-05	Kyger Creek NFAP	X	X	X	X	X
Calcium	BAC-02	Regional Groundwater Discharge	X	X	X	X	X
Chloride	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
pH	BAC-02 BAC-03 BAC-04 BAC-05	Mixing with Ohio River	X	X	X	X	X
Sulfate	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
TDS	BAC-02 BAC-04	Regional Groundwater Discharge	X	X	X	X	X

In conclusion, the BAP is not the source of the SSIs associated with the first semiannual sampling event groundwater results for 2019. Thus, Gavin will continue detection monitoring at the BAP in accordance with 40 CFR § 257.94(e)(2).

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I or an agent under my review has prepared this Alternate Source Demonstration Report for the Bottom Ash Pond and it meets the requirements of 40 CFR § 257.94(e)(2). To the best of my knowledge, the information contained in this Report is true, complete, and accurate.



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FIGURES

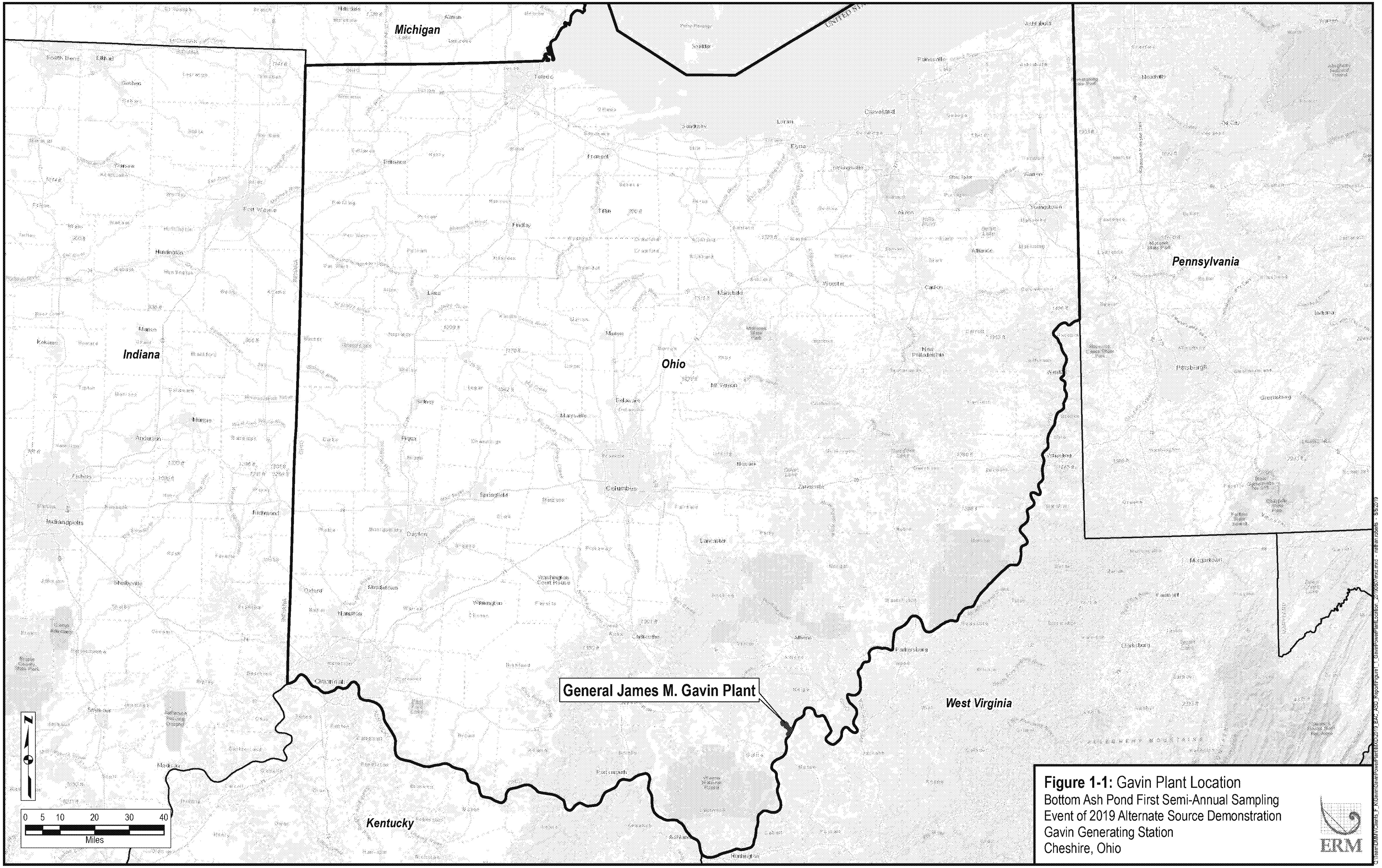
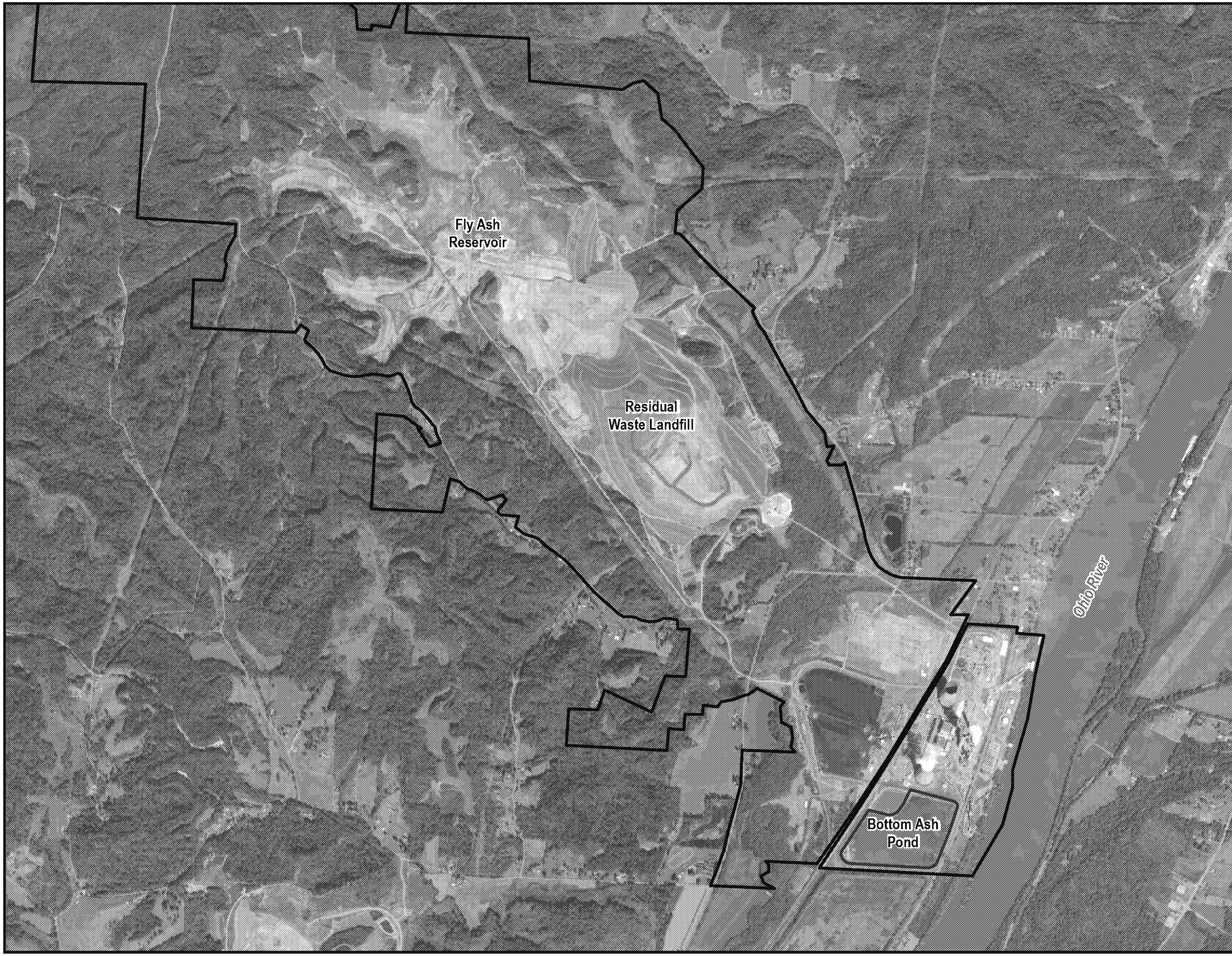
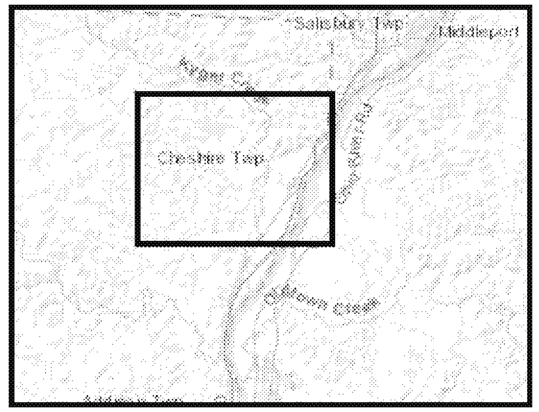


Figure 1-1: Gavin Plant Location
Bottom Ash Pond First Semi-Annual Sampling
Event of 2019 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio





Legend

- Bottom Ash Complex
- Gavin Property Boundary

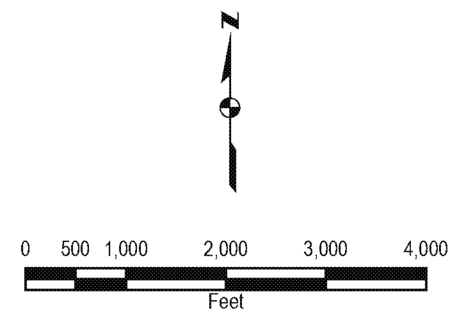
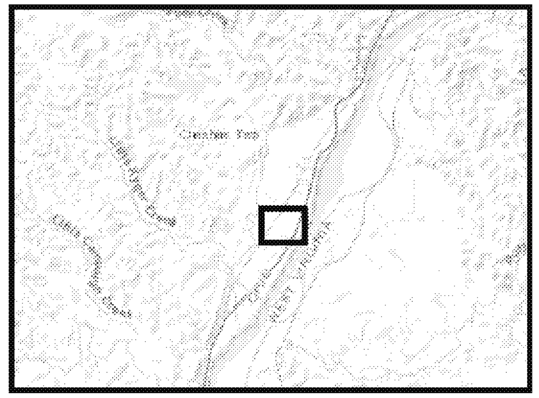


Figure 1-2: Bottom Ash Pond Location
Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



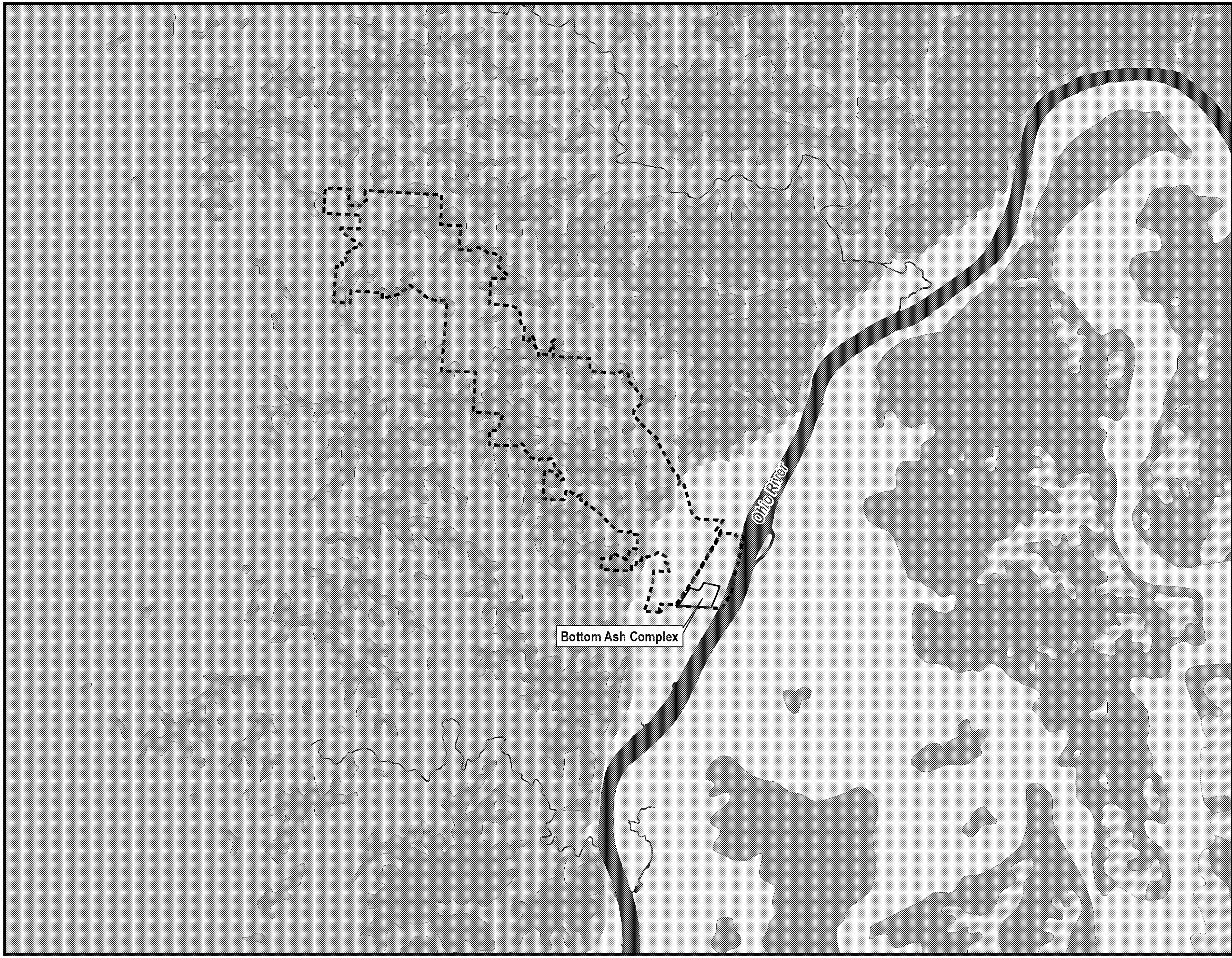
Legend

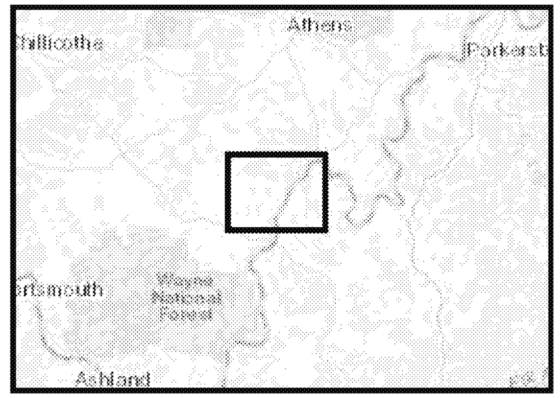
- Federal Sampling Program Groundwater Monitoring Well
- Monitoring Well (Not in Federal Program)

NOTES:
1. Locations are approximate
2. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.4

Figure 1-3: Existing Monitoring Well Network
Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

Dunkard Group

NOTES:

1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

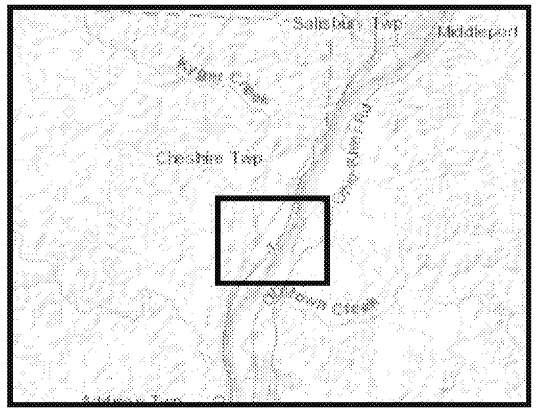
0 0.25 0.5 1 1.5 2

Miles

Figure 2-1: Sedimentary and Alluvial Aquifers

Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

- Federal Sampling Program Groundwater Monitoring Well
- Monitoring Well (Not in Federal Program)
- Gavin Bottom Ash Pond
- Kyger Creek Fly Ash Ponds

NOTES:

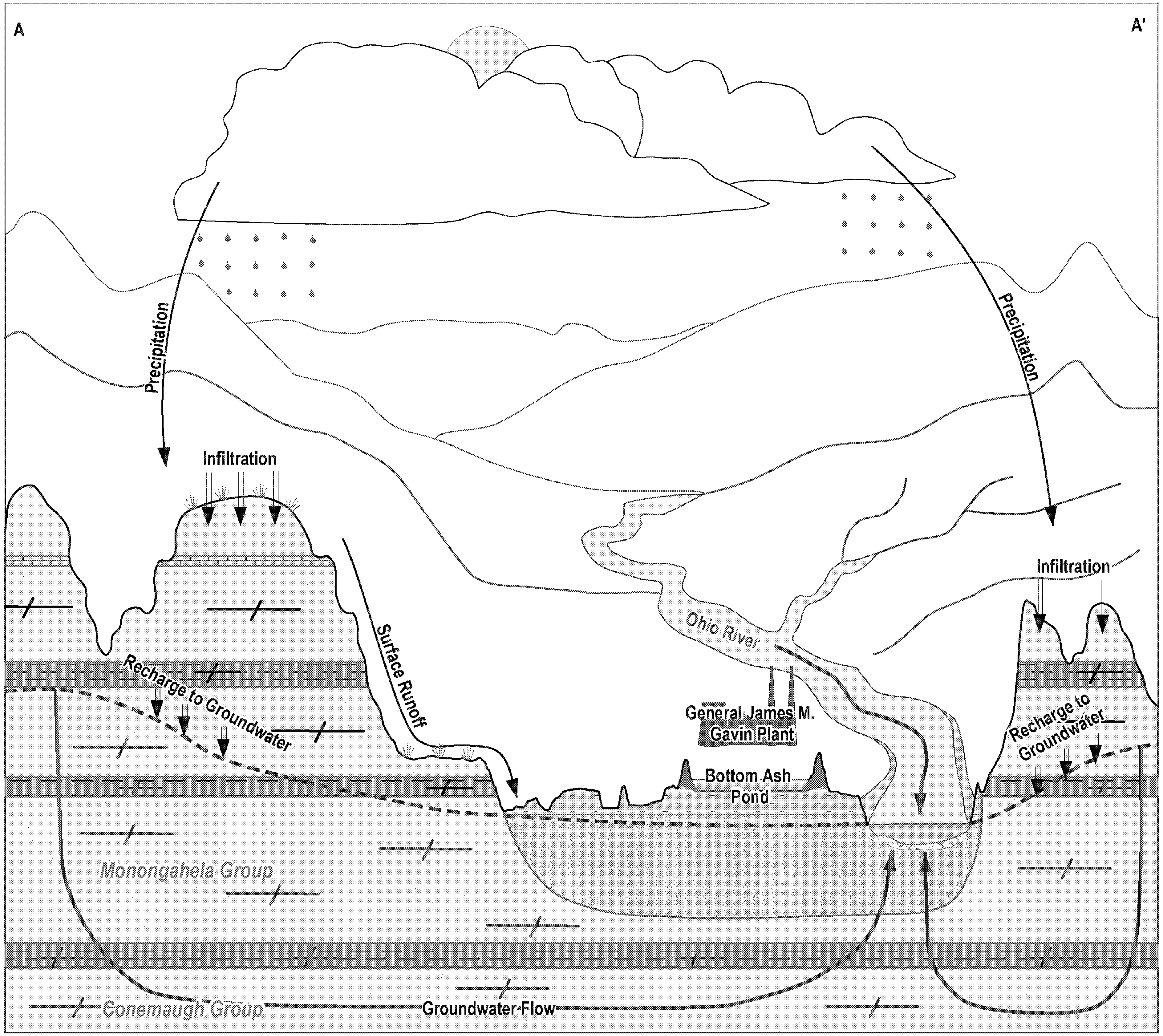
1. Kyger Creek features are from AEP. 1994. Hydrogeologic Site Investigation Plan for the Proposed North Fly Ash Pond Closure, Kyger Creek Station, Ohio Valley Electric Corporation, Gallia County, Ohio.

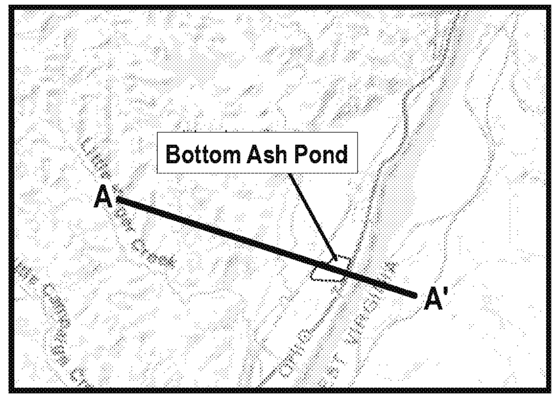
N

0 250 500 1,000 1,500 2,000
Feet

Figure 2-2: Location of Kyger Creek Generating Station
Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

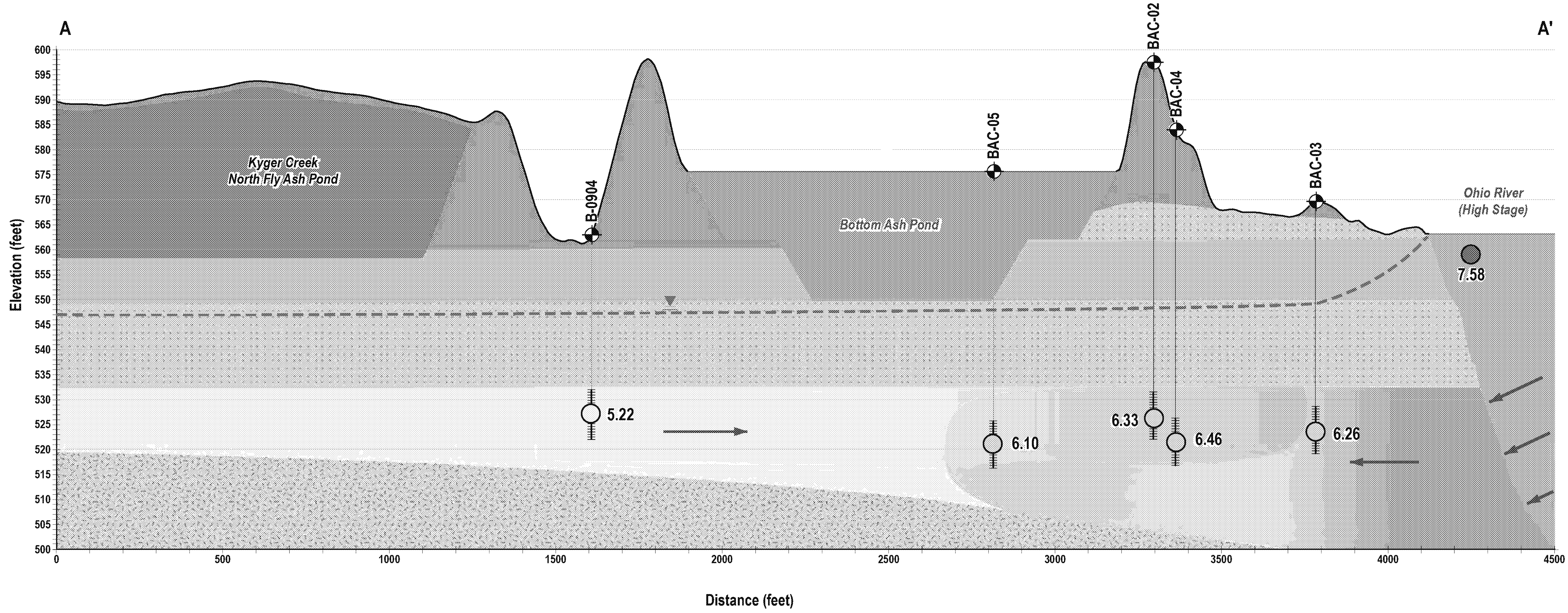
- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Fill
- Interbedded Silt/Clay
- Sand
- Coarse Sand Deposits
- Sandstone
- Fractured Limestone
- Fractured Shale

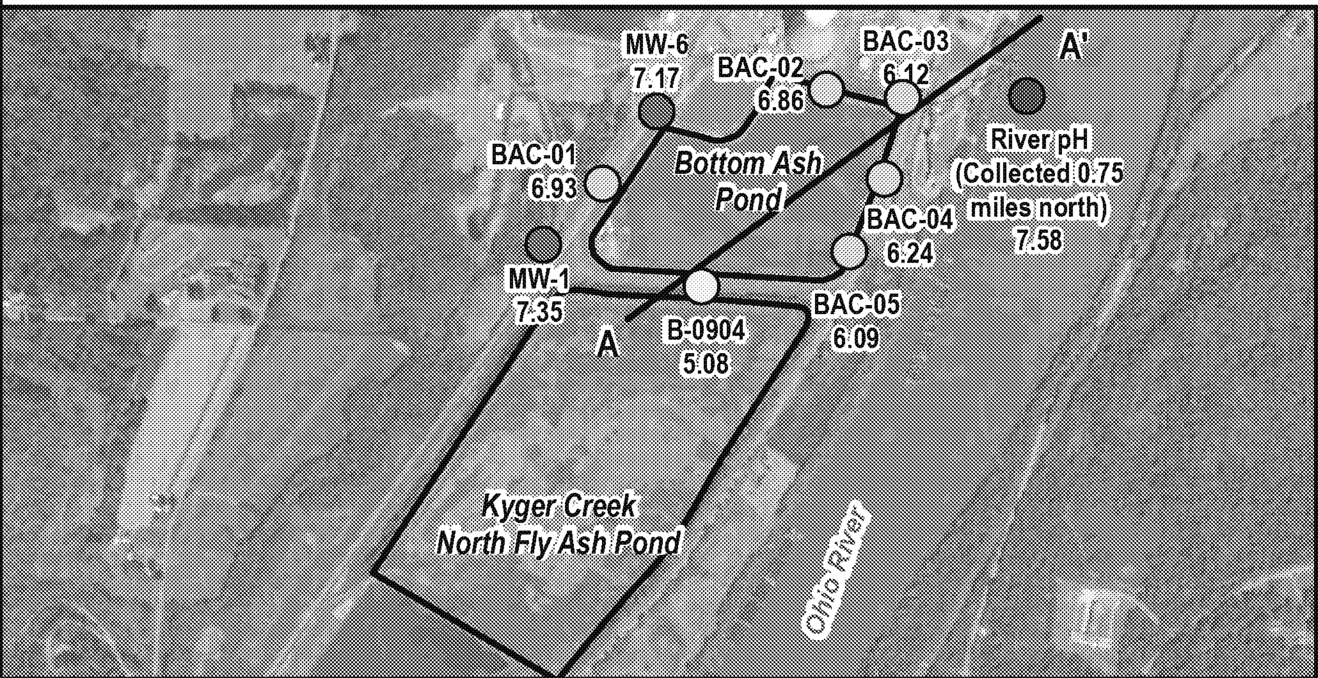
NOTES:

1. Sandstone bedrock units represent the Conemaugh Group and Monongahela Group Sedimentary Aquifers

0 250 500 1,000 1,500 2,000 2,500 3,000
Feet

Figure 3-1: Regional Groundwater Flow Patterns
Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio





Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Potentiometric Surface
- Interpreted Groundwater Flow Direction

pH (Standard Units)

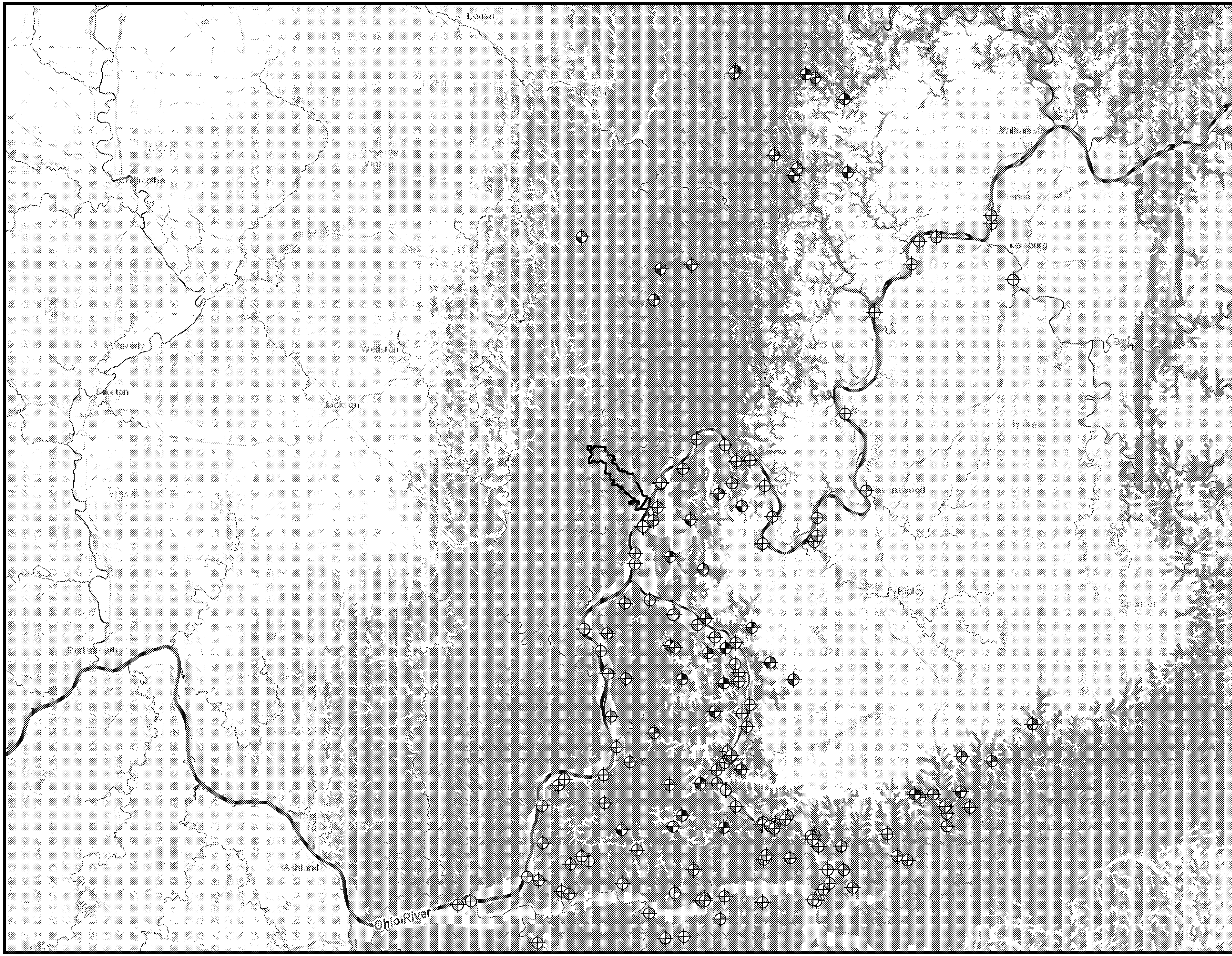
- <6
- 6-7
- >7

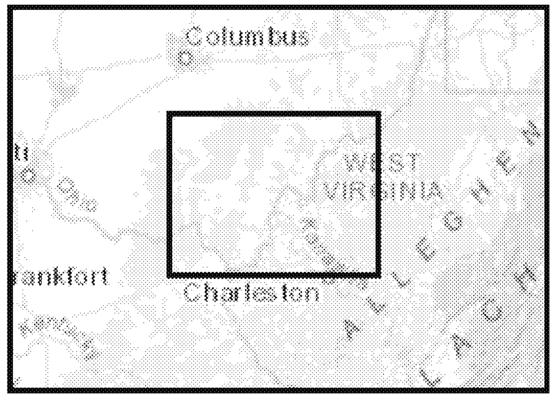
Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 4-1: pH of the Ohio River and BAP Groundwater
Bottom Ash Pond First Semi- Annual Sampling
Event of 2019 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

USGS Groundwater Monitoring Wells

Alluvial Aquifer

Conemaugh Group (Sedimentary Aquifer)

Monongahela Group (Sedimentary Aquifer)

NOTES:

1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 2.5 5 10 15 20

Miles

Figure 4-2: Locations of Background Groundwater Monitoring Wells

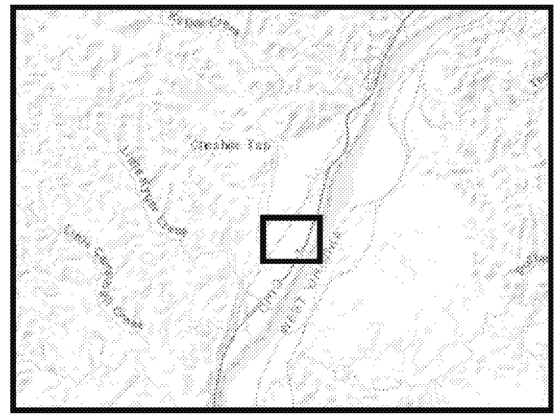
Bottom Ash Pond First Semi-Annual Sampling Event of 2019

Alternate Source Demonstration

Gavin Generating Station

Cheshire, Ohio

ERM



Legend

- **0.054** Boron Concentration (mg/L)
- Low (Typical) River State Groundwater Flow Direction to the Northeast*
- High River Stage Groundwater Flow Direction to the Northwest*
- Coal Combustion Residuals Unit

Boron Concentration in Groundwater

- <2 mg/L
- 2-3 mg/L
- >3 mg/L

Sample Type

- Groundwater
- Surface Water

NOTES:

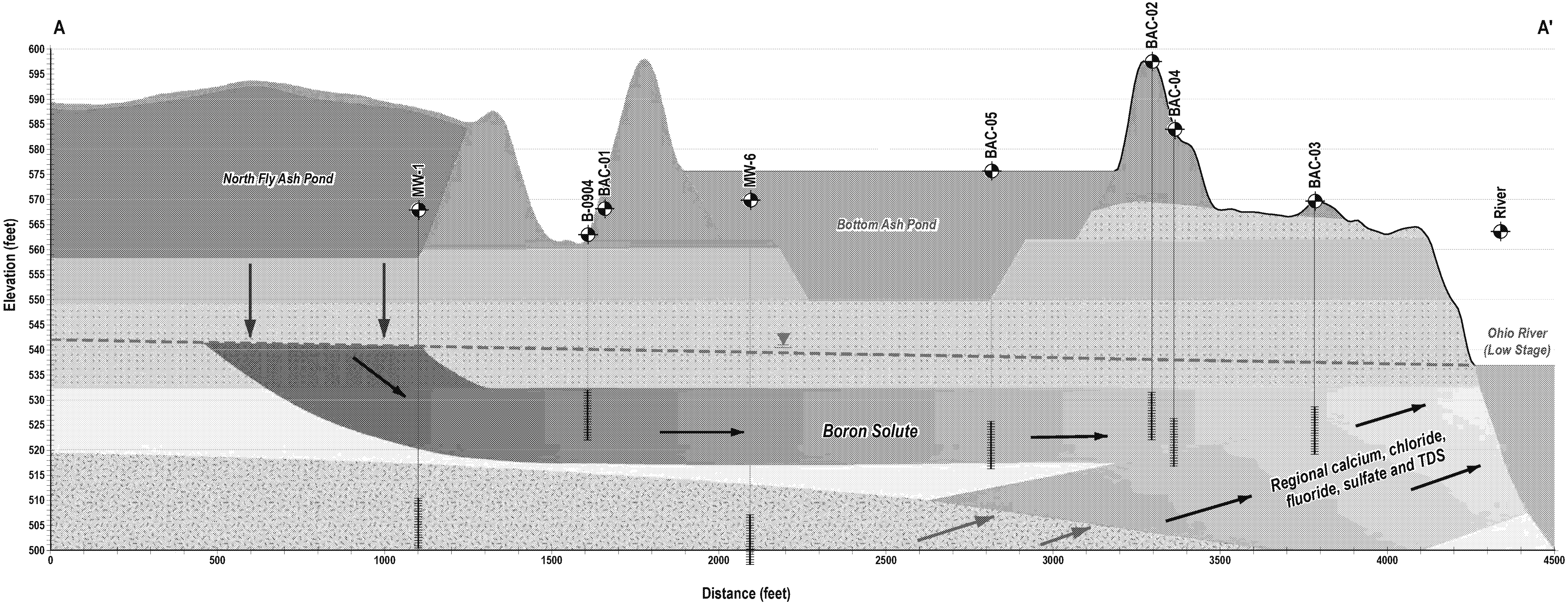
1. Groundwater and surface water data is from March 2019
2. * Arrow length is relative to duration of low, high river stage

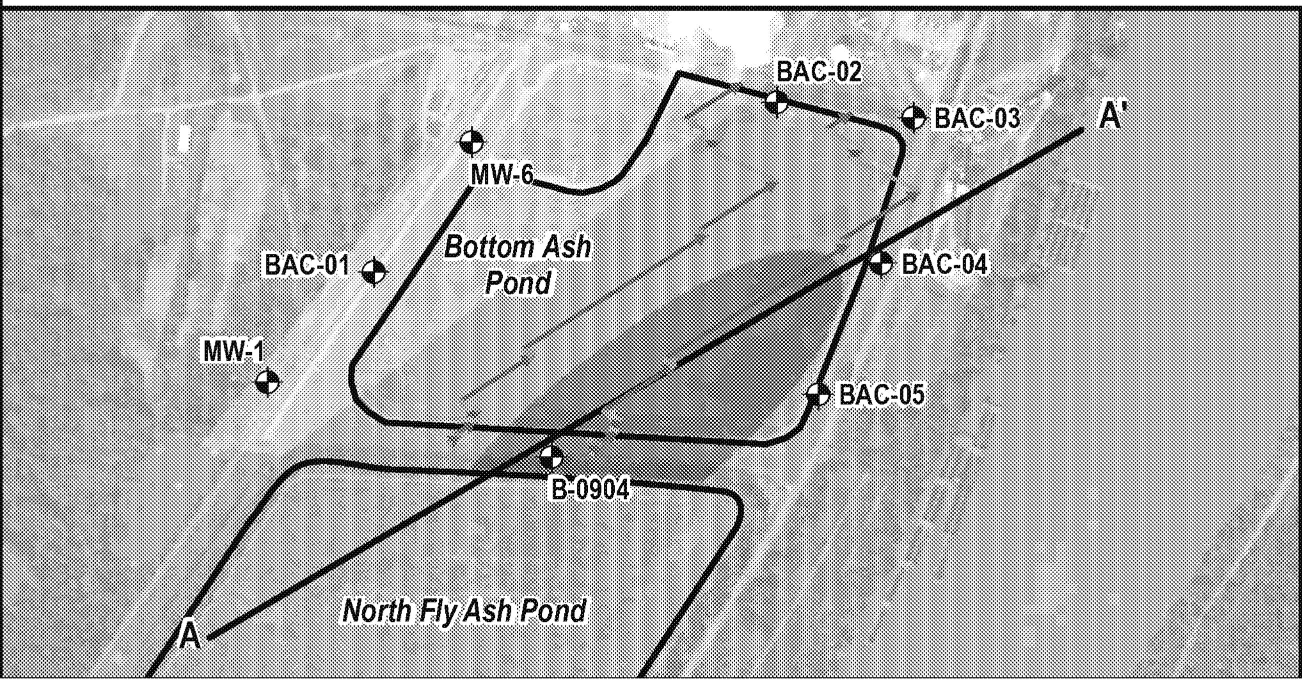
N

0 100 200 300 400 500
Feet

Figure 4-3: Boron Distribution in Groundwater in March 2019
Bottom Ash Pond First Semi-Annual Sampling Event of 2019
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

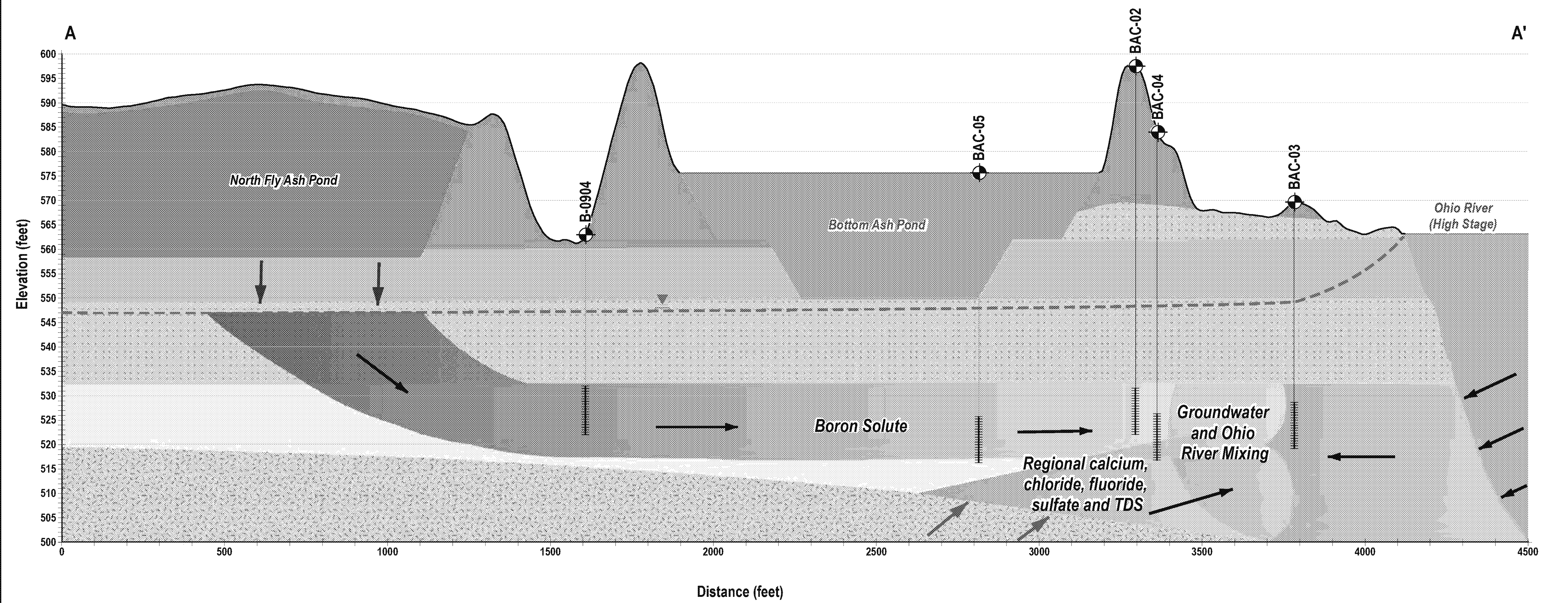
- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted Low River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca, Cl, F, SO_4^{2-}, and TDS

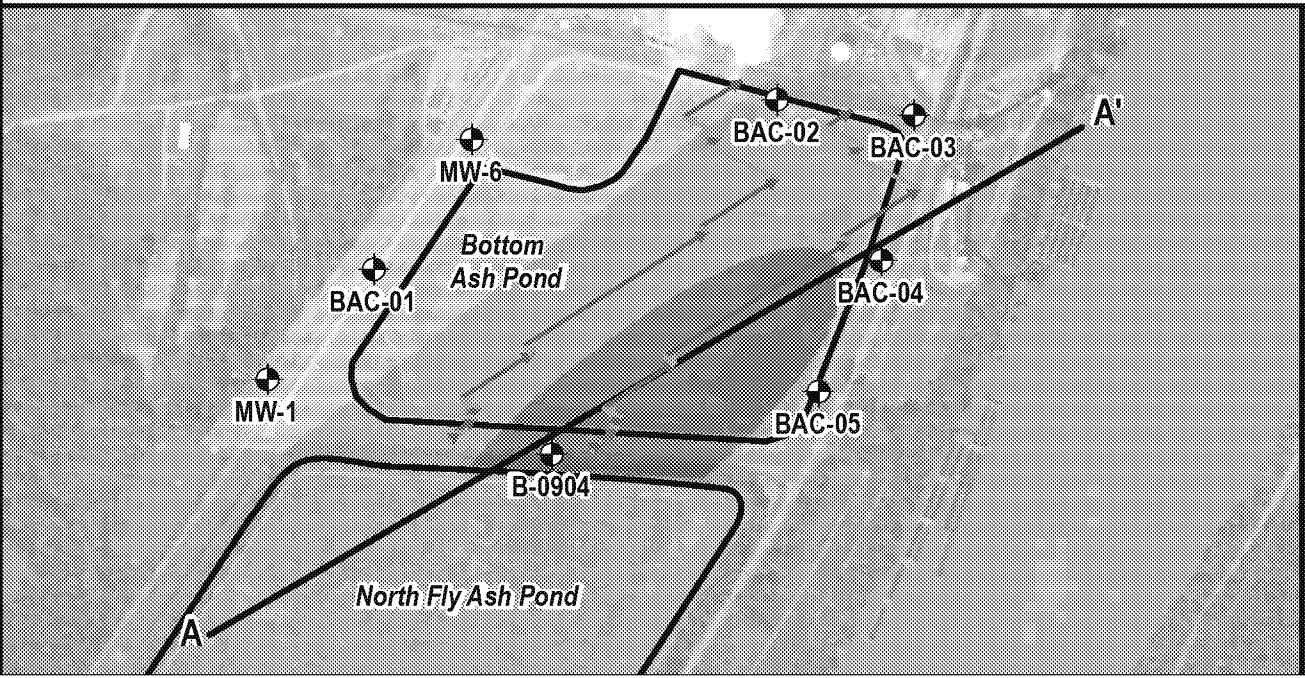
Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Bottom Ash Pond First Semi-Annual Sampling
Event of 2019 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

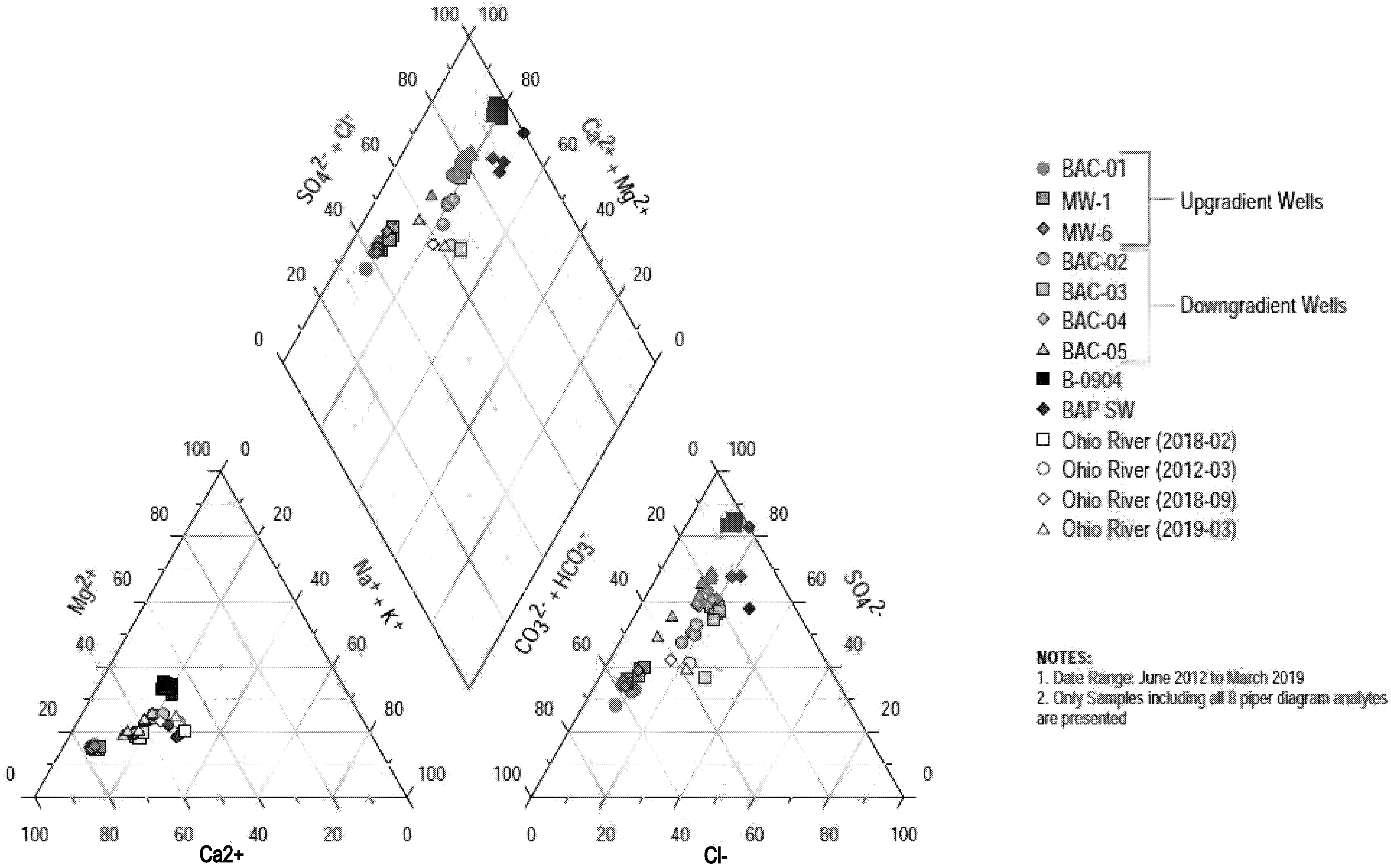
- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Vector
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca, Cl, F, SO_4, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-2: High River Stage Cross Section
Bottom Ash Pond First Semi- Annual Sampling
Event of 2019 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



NOTES:

1. Date Range: June 2012 to March 2019
2. Only Samples including all 8 piper diagram analytes are presented

Figure 6-1: BAP Water Geochemistry

Bottom Ash Pond First Semi Annual Sampling Event of 2019

Gavin Generating Station

Cheshire, Ohio

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APPENDIX B GAVIN BOTTOM ASH POND SECOND SEMIANNUAL SAMPLING EVENT OF 2019 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Bottom Ash Pond

Gavin Power, LLC

Second Semiannual Sampling Event of 2019 Alternate Source Demonstration Report

Gavin Power Plant
Cheshire, Ohio

31 January 2020

Project No.: 0505619

The business of sustainability

ERM

Signature Page

31 January 2020

Gavin Bottom Ash Pond

Second Semiannual Sampling Event of 2019 Alternate Source Demonstration Report

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CONTENTS

List of Figures

Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCR Unit	Bottom Ash Complex CCR Surface Impoundment
CFR	Code of Federal Regulations
Gavin	Gavin Power, LLC
mg/L	milligrams per liter
NFAP	North Fly Ash Pond
Plant	General James M. Gavin Power Plant
SFAP	South Fly Ash Pond
SSI	Statistically significant increase
TDS	Total Dissolved Solids
USGS	United States Geological Survey

1. INTRODUCTION

1.1 Regulatory and Legal Framework

In accordance with 40 Code of Federal Regulations (CFR), Part 257, Subpart D—Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments (CCR Rule), Gavin Power, LLC (Gavin) has been implementing the groundwater monitoring requirements of 40 CFR § 257.90 *et seq.* for its Bottom Ash Pond (BAP) CCR Surface Impoundment (CCR Unit) at the General James M. Gavin Power Plant (Plant). Gavin calculated background levels and conducted statistical analyses for Appendix III constituents in accordance with 40 CFR § 257.93(h). Currently, Gavin is performing detection monitoring at the BAP in accordance with 40 CFR § 257.94. Statistically significant increases (SSIs) over background concentrations were detected in downgradient monitoring wells for Appendix III constituents for the second semiannual groundwater sampling event of 2019 and are explained in this Report.

An SSI for one or more Appendix III constituents is a potential indication of a release of constituents from the CCR unit to groundwater. In the event of an SSI, the CCR Rule provides that "the owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality" (40 CFR § 257.94(e)(2)). If it can be demonstrated that the SSI is due to a source other than the CCR unit, then the CCR unit may remain in the Detection Monitoring Program instead of transitioning to an Assessment Monitoring Program. An Alternate Source Demonstration (ASD) must be made in writing, and the accuracy of the information must be verified through certification by a qualified Professional Engineer (40 CFR § 257.94(e)(2)).

The United States Environmental Protection Agency's guidance document, "Solid Waste Disposal Facility Criteria Technical Manual, EPA530-R-93-017, Subpart E" (USEPA 1993), lays out the following six lines of evidence that should be addressed to determine whether an SSI resulted from a source other than the regulated disposal unit:

1. An alternative source exists.
2. Hydraulic connection exists between the alternative source and the well with the significant increase.
3. Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the unit.
4. The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the unit when the fate and transport characteristics of the constituents are considered.
5. The concentration observed in groundwater could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and site hydrogeologic conditions.
6. The data supporting conclusions regarding the alternative source are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

This ASD Report addresses each of these lines of evidence for the SSIs detected in the groundwater beneath the BAP.

1.2 Background

The Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River (Figure 1-1). The BAP is one of three CCR units at the Plant that are subject to regulation under the

CCR Rule and is located adjacent to and immediately south of the main Plant area along the Ohio River (Figure 1-2). Adjacent to the BAP is the smaller Reclaim Pond (Figure 1-3). The BAP, together with the smaller Reclaim Pond, make up the Bottom Ash Complex (BAC), which has operated since 1974.

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) positioned around the perimeter of the BAP (Figure 1-3). In addition, Monitoring Well B-0904 is south of the BAP and is used in this report to evaluate the quality of groundwater migrating from the Kyger Creek North Fly Ash Pond (NFAP) under the BAP. All of the monitoring wells associated with these units are screened in the uppermost aquifer beneath the BAP. The uppermost aquifer has the following characteristics (Geosyntec 2016):

- It consists of fine to coarse sand with some gravel that grades progressively finer with decreasing depth.
- It is approximately 25 feet to 35 feet thick.
- It is located below an approximately 20-foot-thick silty clay confining layer and above a shale bedrock unit.

Consistent with the CCR Rule and the Groundwater Monitoring Plan developed for Gavin (ERM 2017), a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits, and a lower prediction limit specifically for pH, were established based on the upgradient groundwater data. The 2017 Annual Groundwater Monitoring and Corrective Action Report was prepared to document the status of the groundwater monitoring program for the BAP (ERM 2018a) and included results from eight sampling events performed from August 2016 to August 2017. The report compared upper and lower prediction limits to the most recent results from the downgradient wells. Additionally, the following reports were previously prepared to identify alternate sources for each SSI:

- The Gavin BAC ASD Report (ERM 2018b) addressed SSIs associated with the August 2016 to August 2017 period.
- The Gavin BAC First Semiannual Sampling Event of 2018 ASD Report (ERM 2018c) addressed SSIs associated with the May 2018 sampling event.
- The Gavin BAC Second Semiannual Sampling Event of 2018 ASD Report (ERM 2019a) addressed SSIs associated with the September 2018 sampling event.
- The Gavin BAC First Semiannual Sampling Event of 2019 ASD Report (ERM 2019b) addressed SSIs associated with the March 2019 sampling event.

The second semiannual groundwater sampling event of 2019 was performed in September 2019. The data from this sampling event were compared to the upper and lower prediction limits, and SSIs for Appendix III analytes were determined. Table 1-1 summarizes results from this sampling event.

Table 1-1: SSIs in Groundwater beneath the BAP

Analyte	Monitoring Well			
	BAC-02	**BAC-03**	**BAC-04**	**BAC-05**
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
Total Dissolved Solids	X	ϕ	ϕ	ϕ

Notes: ϕ = No SSI; X = SSI; BAP = Bottom Ash Pond; SSI = statistically significant increase
Results are for the downgradient wells sampled in September 2019.

Consistent with previous ASD Reports, this ASD Report identifies the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. This ASD report also identifies regional discharge of groundwater as the source of calcium, chloride, sulfate, and total dissolved solids (TDS) and the Kyger Creek NFAP as the source of boron. Supporting information and additional discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this report.

2. DESCRIPTION OF ALTERNATE SOURCES

The first ASD Report for the BAP (ERM 2018b) identified and described in detail three alternate sources for the Appendix III constituents: the Ohio River, the regional geology, and the neighboring Kyger Creek Generating Station. A summary of each of these alternate sources is provided below.

2.1 Ohio River

The Ohio River extends approximately 981 river miles from Pittsburgh, Pennsylvania to Cairo, Illinois and drains an area of approximately 205,000 square miles (ORSANCO 2018). The Ohio River is approximately 700 feet east of the BAP, and the alluvial aquifer beneath the BAP is hydraulically connected to the river. When the Ohio River floods, water from the river mixes with groundwater within the alluvial aquifer (ERM 2018b) beneath the BAP. The mixing of groundwater and river water is discussed in Section 3, and the quality of the Ohio River water that mixes with groundwater is discussed in Section 4.

2.2 Regional Background

The regional bedrock geology near the Plant includes Pennsylvanian-age sedimentary rocks from the Monongahela and Conemaugh Formations, with the Morgantown and Cow Run Sandstone members being part of the latter. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). Overlying the Pennsylvanian-age rocks are Quaternary-age alluvium that consists primarily of sand, silt, clay, and gravel (OEPA 2018). The sedimentary rocks form the ridges and valleys west of the Ohio River, and the unconsolidated sand, silt, clay, and gravel are located along the Ohio River and tributaries. The consolidated sedimentary rocks and the unconsolidated alluvium form the two major aquifers near the Plant (Figure 2-1). The interaction of groundwater with rocks and minerals within these aquifers can influence the concentration of Appendix III constituents, for example via dissolution (ORSANCO 1984).

Naturally occurring brine, which is known to be rich in calcium, chloride, sulfate, fluoride, and other trace elements, exists in the subsurface in the Ohio River Valley (Stout et al. 1932; ORSANCO 1984; ODNR 1995). Some of the brines also exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles southwest of the Plant in Gallipolis, Ohio and was utilized for the commercial production of salt starting in 1807 (Geological Survey of Ohio 1932). Naturally occurring brine was also identified at the land surface in Jackson, Ohio, approximately 30 miles west of the Plant (ODNR 1995). The regional presence of shallow brine indicates the potential for naturally occurring brine to contribute Appendix III constituents to groundwater at the Plant.

To account for natural and anthropogenic influences on Appendix III constituents on a regional scale, background groundwater data were obtained from United States Geological Survey (USGS) databases. The background groundwater data set is discussed further in Section 4.

2.3 Kyger Creek Generating Station

The Kyger Creek Generating Station is located along the Ohio River in Gallia County, south of the Plant (Figure 2-2). The Kyger Creek Fly Ash Pond complex consists of the 110-acre North Fly Ash Pond (NFAP) and 60-acre South Fly Ash Pond (SFAP). The construction history and groundwater monitoring results of these ponds are summarized in the first ASD Report (ERM 2018b). The Kyger Creek NFAP is located less than 300 feet from the BAP, and the units share an approximately 2,000-foot-long border (Figure 2-2). The Kyger Creek NFAP has a higher potential to impact groundwater than the BAP because the Kyger Creek NFAP contains fly ash, which, when compared to bottom ash, has a greater tendency to leach CCR constituents (Cox et al. 1978; Jones et al. 2012). This is described further in Section 7.

3. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

Detailed explanations of the hydraulic connections between the alternate sources and the downgradient wells of the BAP were previously provided in the first ASD Report for the BAP (ERM 2018b). A summary of each of these connections is provided below.

3.1 Ohio River

Both the Gavin BAP and the Kyger Creek NFAP are located above the alluvial aquifer (Geosyntec 2016; AGES 2016; ERM 2018b). Groundwater in the alluvial aquifer typically flows from the vicinity of the BAP and Kyger Creek NFAP toward the Ohio River (ERM 2018b). Exceptions to this flow direction occur when the river stage (elevation of the surface water in the river) exceeds approximately 540 feet above mean sea level (ERM 2018b). When this occurs, groundwater flow reverses and flows generally westward from the Ohio River toward the BAP and Kyger Creek NFAP (ERM 2018b). The correlation of the flow reversals with Ohio River flooding is strong evidence that the alluvial aquifer is hydraulically connected to the Ohio River (ERM 2018b).

3.2 Regional Background

Regional groundwater within the fractured sedimentary bedrock flows from northwest to southeast toward the Ohio River (ORSANCO 1984). Precipitation that falls in areas of higher topographic elevation northwest of the Plant infiltrates the land surface and recharges the underlying aquifers. Groundwater then flows from areas of higher topographic elevation, which correspond to high hydraulic head, to areas of lower topographic elevation, which correspond to low hydraulic head. As groundwater flows from northwest to southeast, it migrates both horizontally and vertically through the fracture network within the sedimentary bedrock. Near the Plant, groundwater in the bedrock aquifer mixes with groundwater in the alluvial aquifer, which then discharges to the Ohio River (Figure 3-1). Thus, regional groundwater is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b).

3.3 Kyger Creek Generating Station

The Ohio River stage elevation records were used to identify the frequency and duration of flow reversals, and were combined with the groundwater velocity estimates to develop groundwater flow paths under the BAP (ERM 2018b). There are three key points associated with the interpreted groundwater flow paths:

- The Kyger Creek NFAP is hydraulically upgradient of the four monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) that are downgradient of the Gavin BAP.
- Due to the northeast flow direction, the Kyger Creek NFAP is not upgradient of the western edge of the BAP, where upgradient Monitoring Wells MW-1, BAC-01, and MW-6 are located.
- State Monitoring Well B-0904 is directly downgradient of the Kyger Creek NFAP and upgradient of the BAP.

It is evident that the Kyger Creek NFAP is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b) based on the average northeastern direction of groundwater flow and the presence of the same alluvial aquifer beneath both the Kyger Creek NFAP and the Gavin BAP.

4. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG THE FLOW PATHWAYS

4.1 Ohio River

The pH of the Ohio River is near neutral and the pH of groundwater emanating from the Kyger Creek NFAP, as observed in well B-0904, is slightly acidic (ERM 2018b). As described in Section 3, the hydrogeologic data indicate that water from the Ohio River mixes with groundwater in the alluvial aquifer during times of river flooding. This mixing process results in an intermediate pH, that is between the pH of the Ohio River and the pH of the Kyger Creek NFAP . Table 4-1 and Figure 4-1 summarize this pattern observed in the March 2019 data (well B-0904 was not sampled in September).

Table 4-1: Groundwater and Surface Water pH Values

Location	pH
Kyger Creek NFAP Groundwater (B-0904, March 2019)	5.22
BAP Downgradient Groundwater (BAC-02 through BAC-05, March 2019)	6.10–6.46
Ohio River (March 2019)	7.58

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond

The March 2019 results remain consistent with previous ASD reports for the BAP (ERM 2018b; ERM 2018c; ERM 2019a; ERM 2019b). These results demonstrate the pH of the Ohio River water is higher than Kyger Creek groundwater, and the mixing of these waters results in the intermediate pH observed in groundwater downgradient of the BAP.

4.2 Regional Background

Regional background groundwater quality data were obtained from the USGS National Water Information System database. Groundwater results were selected for monitoring wells constructed within the alluvial, Monongahela Group and Conemaugh Group aquifers located within 50 miles of the Plant (Figure 4-2). The USGS background data were compared to downgradient BAP data (Wells BAC-02, BAC-03, BAC-04, and BAC-05) and Ohio River data collected in September 2019. As shown in Table 4-2, the concentrations of calcium, chloride, sulfate, and TDS in groundwater downgradient of the BAP are between the concentrations in USGS background data for groundwater and the Ohio River. These results are consistent with previous ASD reports for the BAP (ERM 2018b; ERM 2018c; ERM 2019a; ERM 2019b) and, along with Figure 3-1, demonstrate that calcium, chloride, sulfate, and TDS are present along flow pathways from the sedimentary bedrock aquifers to the alluvial aquifer beneath the BAP.

Table 4-2: Comparison of USGS Regional Background to BAP and Ohio River

Analyte	Units	USGS Background (Max)	Downgradient BAP[a]	Ohio River[a]
Calcium	mg/L	520	69 - 130	44
Chloride	mg/L	9,900	32 - 68	37
Sulfate	mg/L	2,700	210 - 310	91
TDS	mg/L	9,910	450 - 580	240

Notes: BAP = Bottom Ash Pond; mg/L = milligrams per liter; TDS = total dissolved solids; USGS = United States Geological Survey
[a] Results from samples collected in September 2019.

4.3 Kyger Creek Generating Station

The concentration of boron in groundwater downgradient of the BAP (Figure 4-3) ranges from 1.4 milligrams per liter (mg/L) to 2.7 mg/L in the September 2019 samples. Figure 4-3 depicts the distribution of boron at the northern boundary of the Kyger Creek NFAP and along the flow pathways as summarized below:

- The highest boron concentrations in BAP downgradient wells were measured at wells BAC-05 and BAC-04, which are located downgradient of the Kyger Creek NFAP. Monitoring Well B-0904 is situated downgradient of the Kyger Creek NFAP and upgradient of the BAP. Although well B-0904 was not sampled in September 2019, the four previous ASD reports included results from this location and provided evidence of the Kyger Creek NFAP as the source of boron detected in the downgradient BAP wells (ERM 2018b; ERM 2018c; ERM 2019a; ERM 2019b).
- Concentrations decrease with distance downgradient from the Kyger Creek NFAP along the northeastern flow path.

In addition to the Ohio Environmental Protection Agency correspondence that concluded that groundwater below the Kyger Creek NFAP appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]), the Kyger Creek SFAP data also suggest boron is present in groundwater below both Kyger Creek fly ash ponds. Table 4-3 summarizes boron analytical results from eight groundwater sampling events conducted between October 2015 and September 2017 at Kyger Creek SFAP downgradient monitoring wells (AGES 2018).

Table 4-3: Kyger Creek SFAP Boron Results

Analyte	Units	Maximum	Average
Boron	mg/L	17.7	6.8

Notes: mg/L = milligrams per liter; SFAP = South Fly Ash Pond

The average concentration of boron (6.8 mg/L) in the Kyger Creek SFAP is higher than the highest concentration of boron measured in groundwater beneath the BAP (2.7 mg/L) in September 2019. The Kyger Creek SFAP and NFAP both manage fly ash generated at the Kyger Creek Generating Station, so it is reasonable to expect that the chemical characteristics of the landfilled fly ash are similar in both units. Given the elevated boron concentrations in groundwater downgradient of the Kyger Creek SFAP and considering that both units are unlined, elevated concentrations of boron in groundwater downgradient of the Kyger Creek NFAP are expected. Thus, this evidence supports the conclusion that boron is present at the Kyger Creek Generating Station.

5. LINKAGES OF CONSTITUENT CONCENTRATIONS AND DISTRIBUTIONS BETWEEN ALTERNATE SOURCES AND DOWNGRADIENT WELLS

5.1 Ohio River

As described in Section 3 and in detail in the first ASD Report for the BAP (ERM 2018b), the groundwater elevation and flow directions provide strong evidence of groundwater flow reversals and the mixing of Ohio River surface water and groundwater. The intermediate pH of groundwater downgradient of the BAP (i.e., the value between the pH of Kyger Creek groundwater and the pH of the Ohio River) is consistent with the mixing of surface water and groundwater. This evidence shows there is a linkage between groundwater downgradient of the BAP and the Ohio River.

5.2 Regional Background

As described in Section 3.2 and illustrated on Figure 3-1, groundwater flowing in the sedimentary bedrock aquifers discharges to the alluvial aquifer along the Ohio River, including the portion beneath the BAP. As described in Section 4.2, regional concentrations of calcium, chloride, sulfate, and TDS are higher than respective groundwater concentrations downgradient of the BAP. Based on these observations, it is likely that the discharge of groundwater from the sedimentary bedrock aquifers to the alluvial aquifer under the BAP (Figure 5-1 and Figure 5-2) is an alternate source for these constituents. This evidence suggests that there is a linkage between groundwater downgradient of the BAP and regional background.

5.3 Kyger Creek Generating Station

When the river stage is low (Figure 5-1), groundwater in the alluvial aquifer migrates in a northeasterly direction from the Kyger Creek NFAP, under the BAP, and eventually discharges to the Ohio River. During times of higher river stage (Figure 5-2), groundwater in the alluvial aquifer temporarily reverses direction and river water flows into the alluvial aquifer. Despite the temporary reversals of groundwater flow caused by flooding of the Ohio River, however, the overall, long-term flow direction is to the northeast, indicating that the source of boron detected in the monitoring wells downgradient of the BAP is the Kyger Creek NFAP.

6. RELEASES FROM THE BAP ARE NOT SUPPORTED AS THE SOURCES

6.1 Chemical Fingerprints

The geochemical fingerprints of surface water from the BAP, groundwater from the BAP, groundwater from the Kyger Creek NFAP, and surface water from the Ohio River were determined using a piper diagram. The piper diagram is a graphical procedure commonly used to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). The samples presented on the diagram were collected from 2012 through 2019. The primary observations and conclusions based on the BAP piper diagram (Figure 6-1) are the following:

- Multiple samples collected from a single location (e.g., the Ohio River or Well B-0904) tended to be tightly clustered, which indicates the chemical signatures of individual locations were consistent over time.
- Groundwater from BAP upgradient Wells MW-1, BAC-01, and MW-6 has a unique geochemical signature dominated by calcium and bicarbonate. This groundwater flows under the west-northwest portion of the BAP and does not appear to be influenced by the Ohio River or Kyger Creek NFAP.
- Groundwater from Well B-0904, which is downgradient of the Kyger Creek NFAP and upgradient of the BAP, is dominated by calcium and sulfate and has a signature that is distinct from all other chemical signatures on the diagram.
- Surface water from the Ohio River also has a distinct signature that plots closer to the center of the piper diagram.
- Groundwater from BAP downgradient Wells BAC-02, BAC-03, BAC-04, and BAC-05 plots on the piper diagram between the Ohio River and Kyger Creek NFAP groundwater, which is an independent line of evidence that groundwater under a majority of the BAP is a mixture of groundwater from the Kyger Creek NFAP (represented by Well B-0904, which is upgradient of the BAP) and the Ohio River.

Thus, the chemical fingerprints of the waters at issue indicate that the BAP is not the source of the SSIs.

7. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

7.1 Ohio River

The hydraulic connection of the Ohio River to the alluvial aquifer was established after the last deglaciation (Kozar and McCoy 2004). Seasonal flooding of the Ohio River, which has occurred regularly over the period that the Plant has existed, is the driving force behind the mixing of surface water and groundwater. Thus, source data for the Ohio River are historically consistent with hydrogeologic conditions and findings of the monitoring program.

7.2 Regional Background

This report provides background groundwater quality data for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the Plant. Flow patterns of regional groundwater through fractured bedrock near the BAP were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). Assuming a conservatively high effective porosity of 1 percent results in an estimated groundwater velocity for the Morgantown Sandstone and Cow Run Sandstone of 80 feet per year and 50 feet per year (ERM 2020b), respectively; this would allow ample time for groundwater to migrate from upgradient regional sources onto Plant property since the end of the last glaciation. The data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

7.3 Kyger Creek Generating Station

The Kyger Creek NFAP was constructed in 1955 with its base on native soil but without an engineered liner to contain leachate. The unit was used to manage fly ash until it was drained and closed in 1997, although dewatered ash is still present within the Kyger Creek NFAP. Groundwater flows under the Kyger Creek NFAP in a northeasterly direction toward and under the Gavin BAP. Given the six decades that this unit has contained fly ash and the alluvial aquifer groundwater velocity estimates of 1,400 to 2,200 feet per year (ERM 2020a), ample time has passed for groundwater to migrate from the Kyger Creek NFAP beneath the BAP. The following evidence supports the Kyger Creek NFAP as the alternate source of boron:

- The distribution of boron in groundwater beneath the BAP (Section 4).
- Analytical results from groundwater samples collected below the Kyger Creek SFAP suggest boron is present in Kyger Creek groundwater. Given the similarity in construction and types of CCR managed, it is reasonable to interpret Kyger Creek SFAP groundwater data as representative of Kyger Creek NFAP groundwater quality (Section 4).
- The chemical fingerprinting evidence shows groundwater from Kyger Creek mixes with Ohio River water under the BAP (Section 6).
- The Ohio Environmental Protection Agency concluded that groundwater appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]).

In addition, a comparison of the materials managed provides evidence that the BAP is not the source, and the Kyger Creek NFAP is a more likely source of boron. The Kyger Creek NFAP has contained fly ash since 1955, while the BAP has been used primarily for the management of bottom ash since 1974. Bottom ash and fly ash have different physical and chemical properties, and laboratory investigations have demonstrated elements (including Appendix III constituents) have a much greater potential to leach from fly ash compared to bottom ash (Cox et al. 1978; Jones et al. 2012). The higher concentrations of boron observed in Kyger Creek SFAP groundwater compared to the lower concentration of boron observed in groundwater downgradient of the BAP are consistent with the known leaching properties of fly ash and bottom ash. Boron is therefore more likely to leach from the Kyger Creek SFAP than the BAP based on the historical use of each unit. These observations support the conclusion that the Kyger Creek NFAP, and not the BAP, is the source of boron in groundwater under the BAP. Thus, the data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

8. CONCLUSIONS

The SSIs identified in this report are based on samples from monitoring wells downgradient of the BAP taken in September 2019. The data were reviewed for quality assurance, statistically analyzed, and reported to Gavin on 18 December 2019. In response to the SSIs, this ASD Report was prepared within the required 90-day period in accordance with 40 CFR § 257.94(e)(2).

All SSIs in the downgradient BAP monitoring wells have been determined to result from alternate sources: mixing with the Ohio River, regional groundwater discharge, and the Kyger Creek Power Plant. Table 8-1 summarizes the six lines of evidence for each of the SSIs.

Table 8-1: BAP ASD Summary

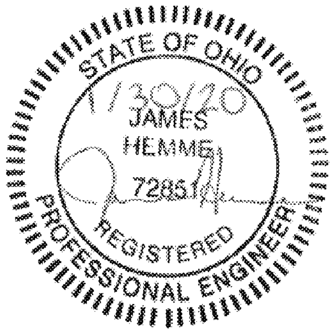
Analyte	SSI Location	Six Lines of Evidence from USEPA Guidance					
		Alternate Source	**Hydraulic Connection**	**Constituent Present at Source or along Flow Path**	**Constituent Distribution More Strongly Linked to Alternate Source**	**Constituent Could Not Have Resulted from the BAP**	**Data Are Historically Consistent with Hydrogeologic Conditions**
Boron	BAC-02 BAC-03 BAC-04 BAC-05	Kyger Creek NFAP	X	X	X	X	X
Calcium	BAC-02	Regional Groundwater Discharge	X	X	X	X	X
Chloride	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
pH	BAC-02 BAC-03 BAC-04 BAC-05	Mixing with Ohio River	X	X	X	X	X
Sulfate	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
TDS	BAC-02	Regional Groundwater Discharge	X	X	X	X	X

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond; SSI = statistically significant increase; TDS = total dissolved solids; USEPA = United States Environmental Protection Agency

In conclusion, the BAP is not the source of the SSIs associated with the second semiannual sampling event groundwater results for 2019. Thus, Gavin will continue detection monitoring at the BAP in accordance with 40 CFR § 257.94(e)(2).

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I, or an agent under my review, have prepared this Alternate Source Demonstration Report for the Bottom Ash Pond and it meets the requirements of 40 CFR § 257.94(e)(2). To the best of my knowledge, the information contained in this Report is true, complete, and accurate.



James A. Hemme, P.E.
State of Ohio License No.: 72851

Date: 1/30/2020

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FIGURES

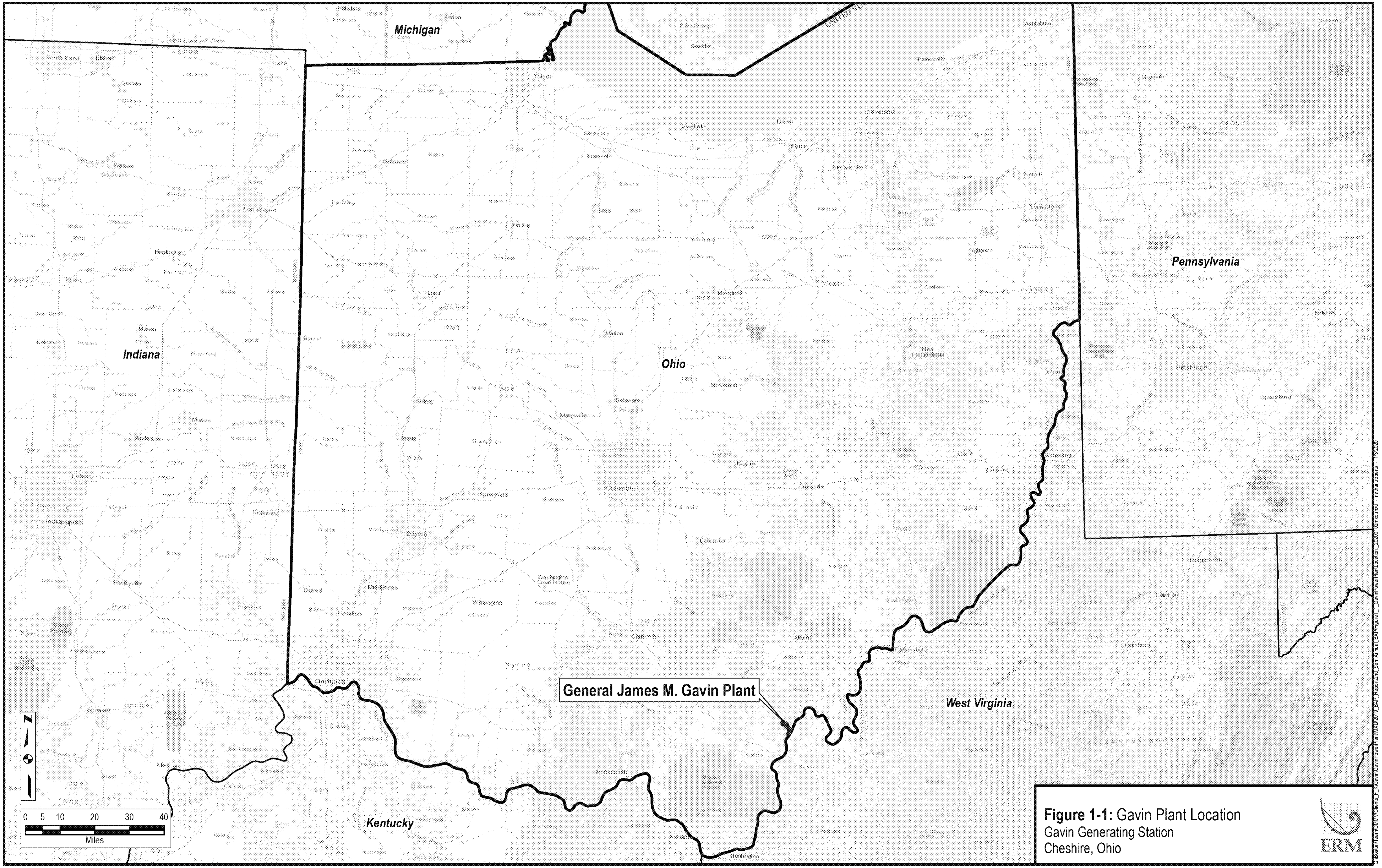


Figure 1-1: Gavin Plant Location
Gavin Generating Station
Cheshire, Ohio

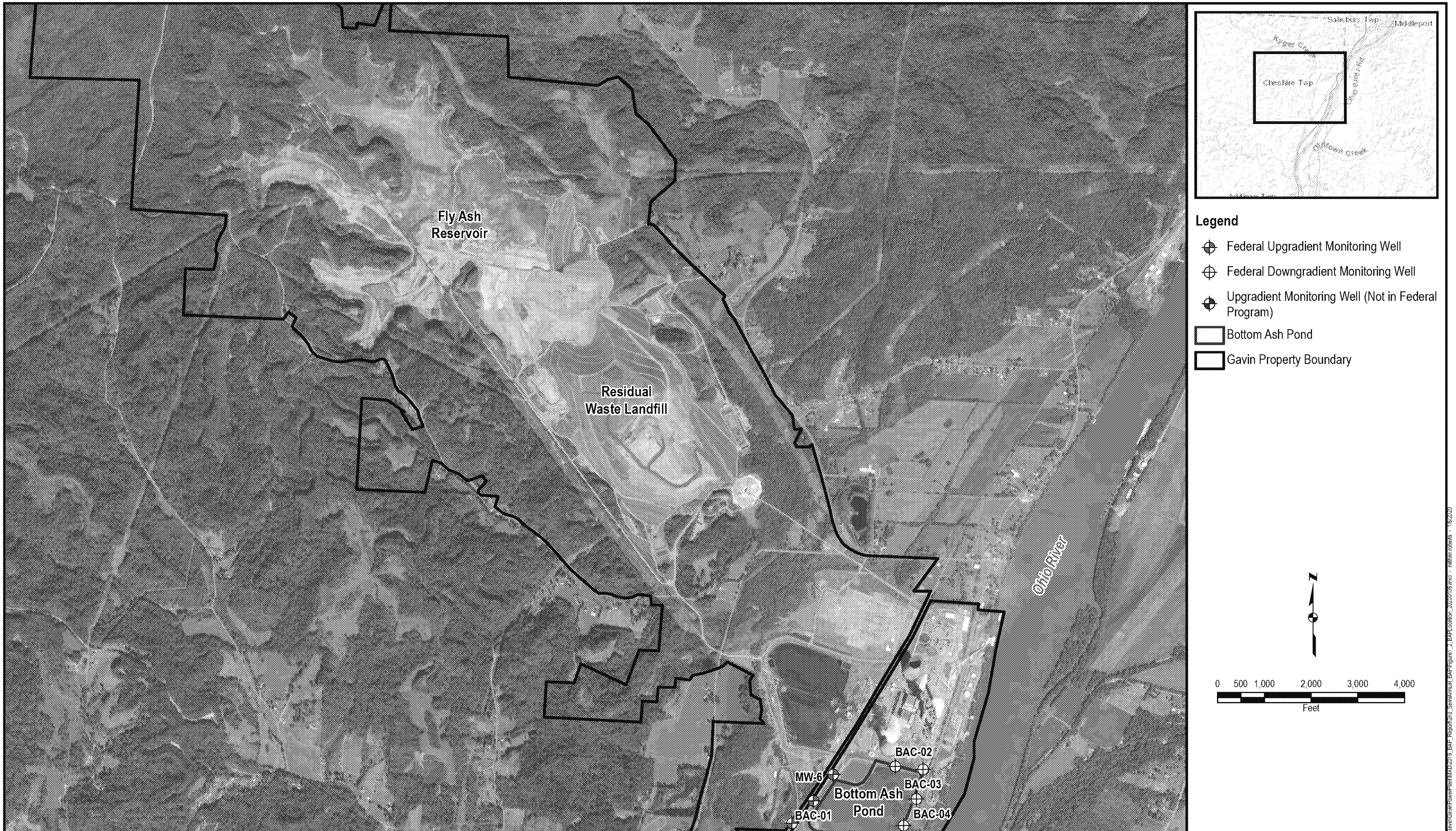


Figure 1-2: Bottom Ash Pond Location
Gavin Generating Station
Cheshire, Ohio

Legend

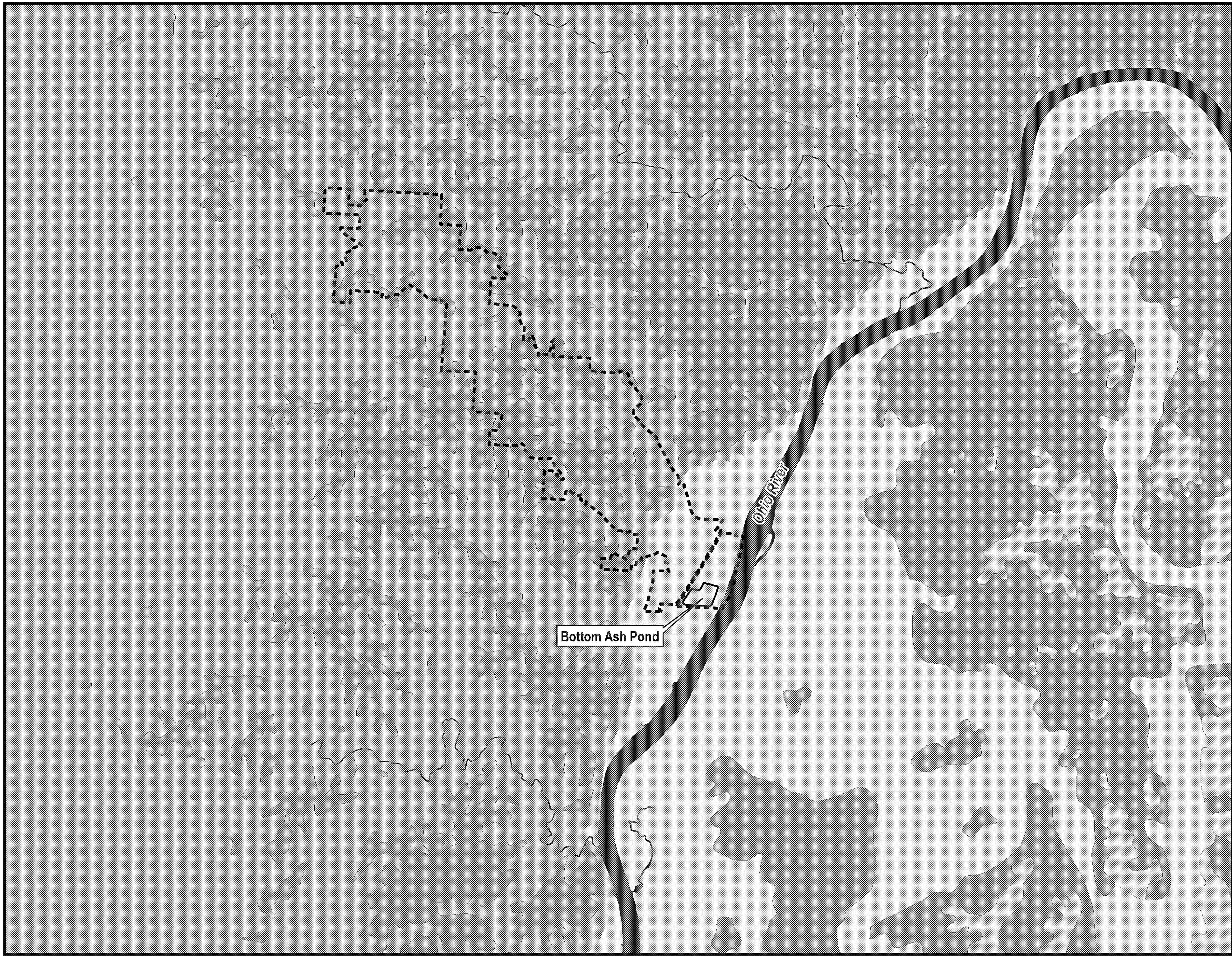
- Federal Sampling Program Groundwater Monitoring Well
- Monitoring Well (Not in Federal Program)

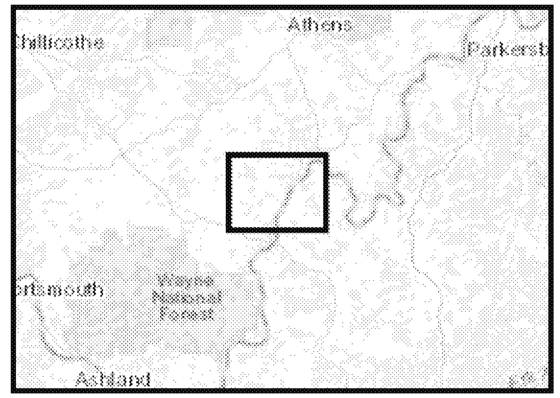
NOTES:
1. Locations are approximate
2. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.4

0 62.5 125 250 375 500
Feet

Figure 1-3: Existing Monitoring Well Network
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

Dunkard Group

NOTES:

1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 0.25 0.5 1 1.5 2

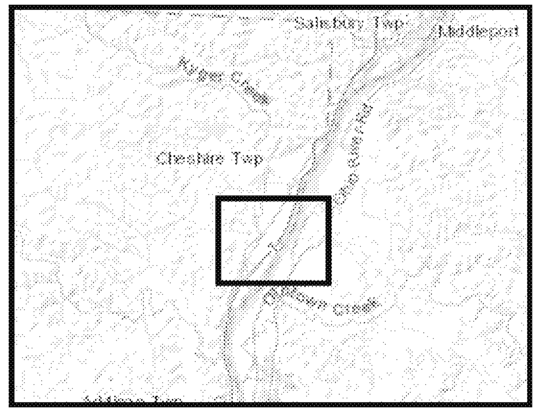
Miles

Figure 2-1: Sedimentary and Alluvial Aquifers

Gavin Generating Station

Cheshire, Ohio

ERM



Legend

- Federal Sampling Program Groundwater Monitoring Well
- Monitoring Well (Not in Federal Program)
- Gavin Bottom Ash Pond
- Kyger Creek Fly Ash

NOTES:

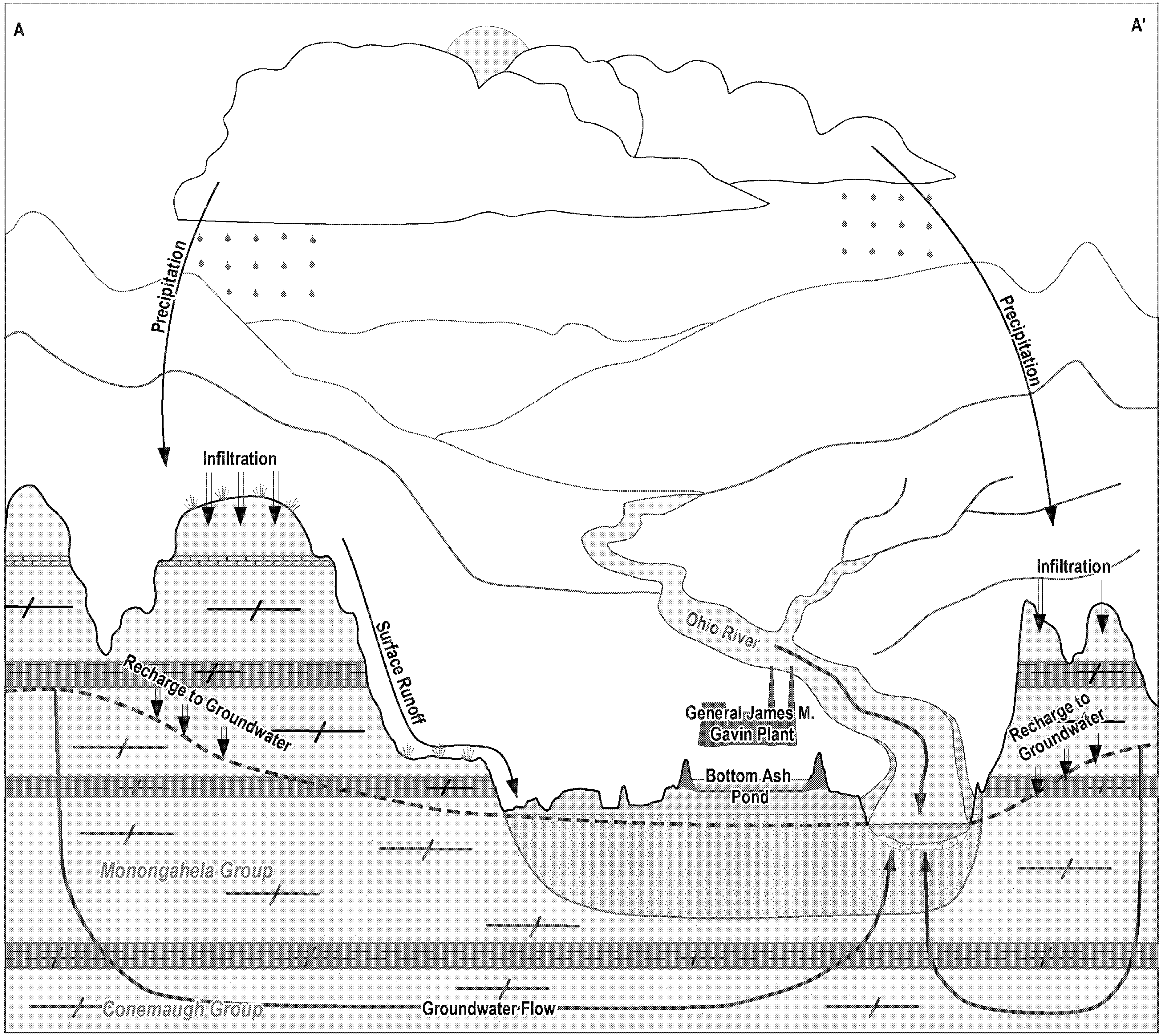
1. Kyger Creek features are from AEP. 1994. Hydrogeologic Site Investigation Plan for the Proposed North Fly Ash Pond Closure, Kyger Creek Station, Ohio Valley Electric Corporation, Gallia County, Ohio.

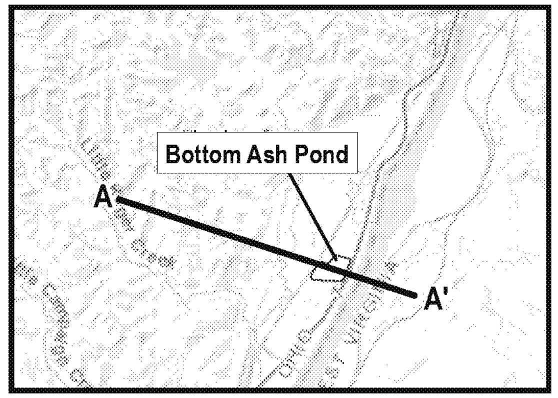
N

0 250 500 1,000 1,500 2,000
Feet

Figure 2-2: Location of Kyger Creek Generating Station
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Fill
- Interbedded Silt/Clay
- Sand
- Coarse Sand Deposits
- Sandstone
- Fractured Limestone
- Fractured Shale

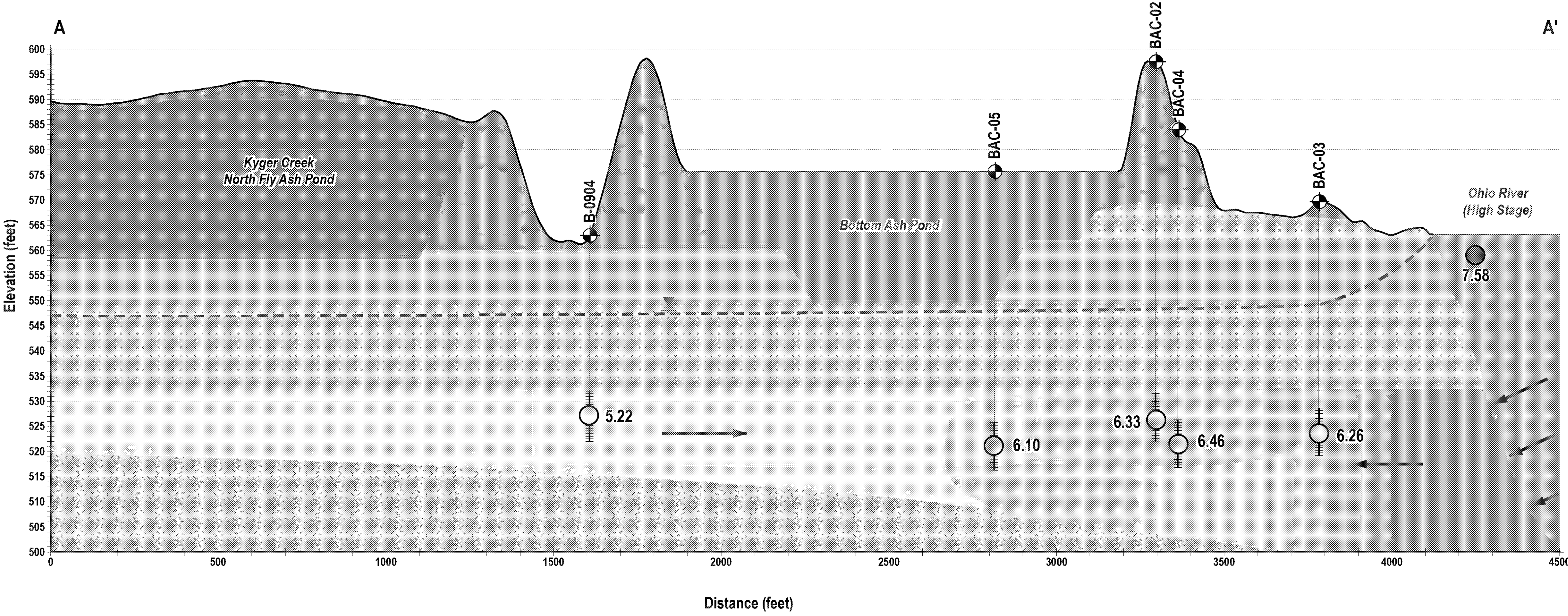
NOTES:

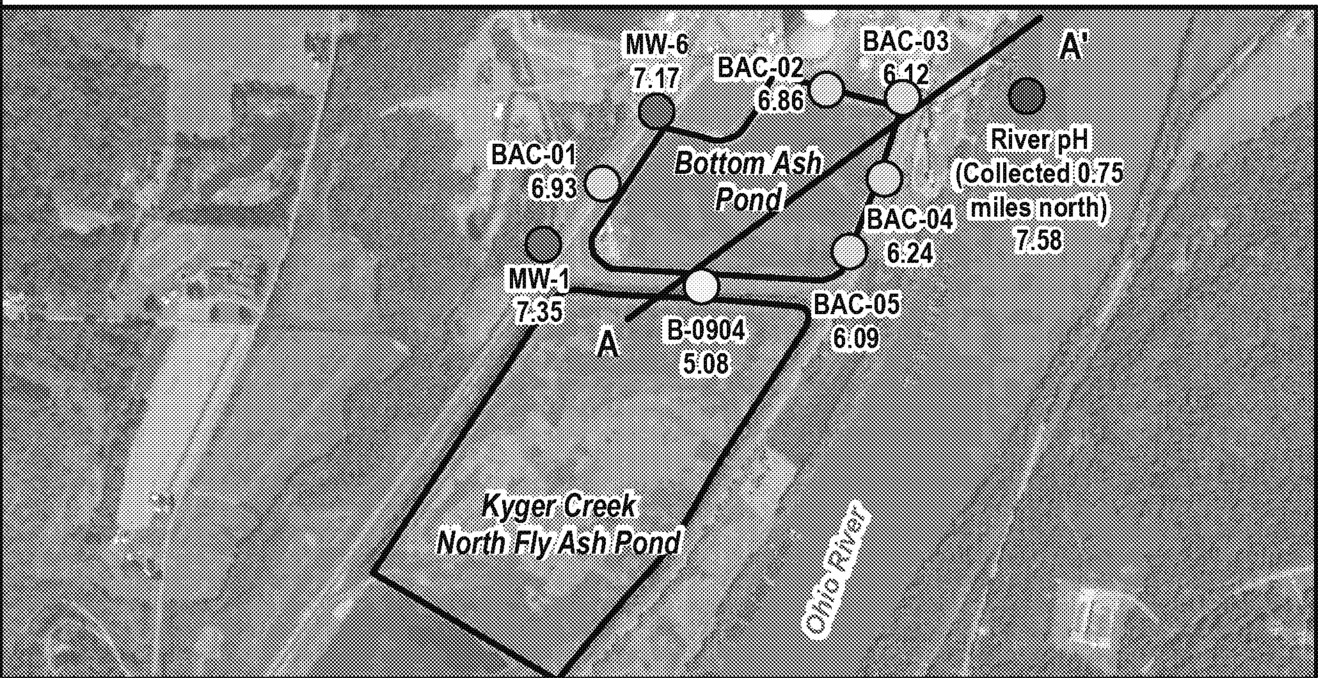
1. Sandstone bedrock units represent the Conemaugh Group and Monongahela Group Sedimentary Aquifers

0 250 500 1,000 1,500 2,000 2,500 3,000
Feet

Figure 3-1: Regional Groundwater Flow Patterns
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Potentiometric Surface
- Interpreted Groundwater Flow Direction

pH (Standard Units)

- <6
- 6-7
- >7

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 4-1: pH of the Ohio River and BAP Groundwater
March 2019
Gavin Generating Station
Cheshire, Ohio

ERM

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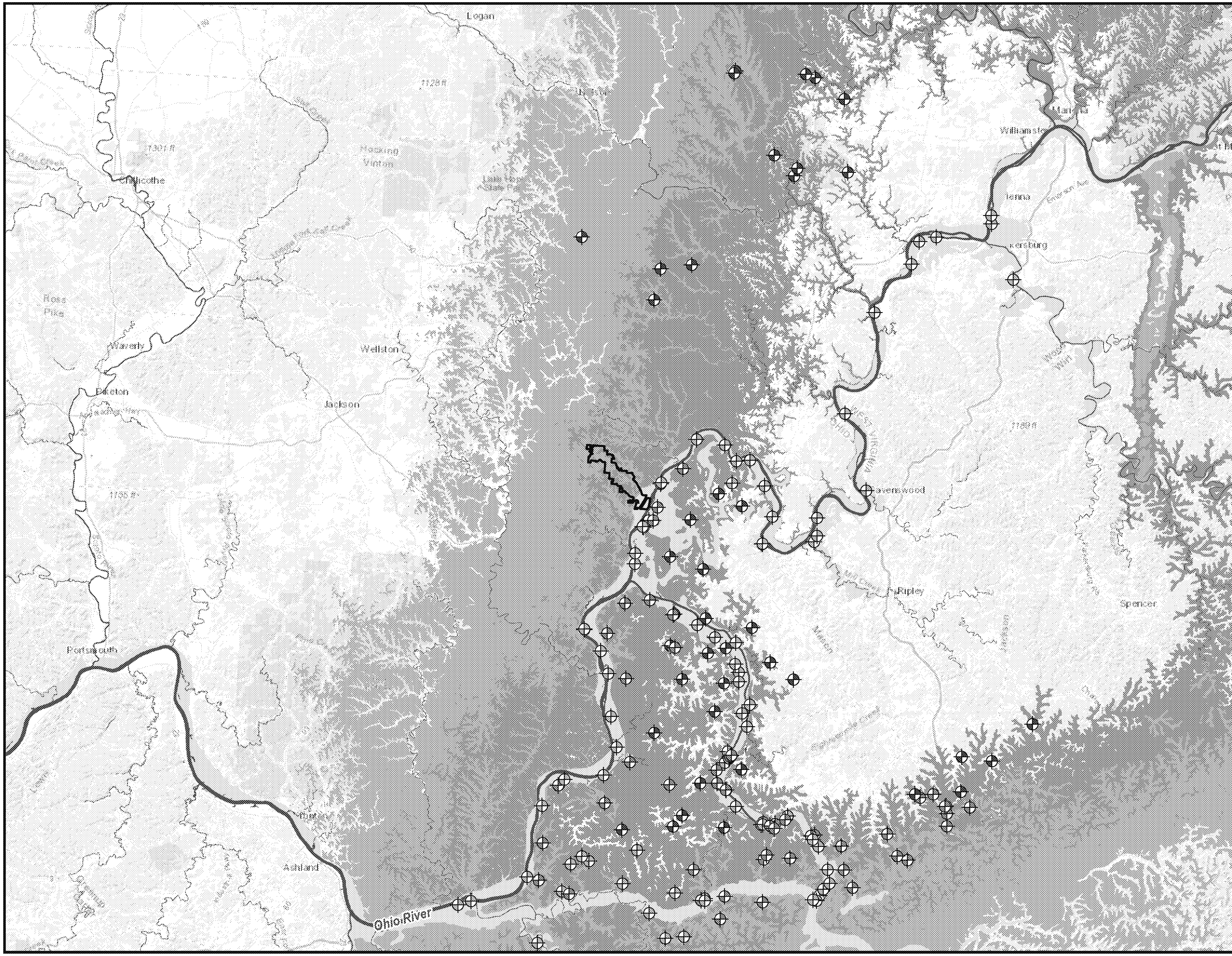
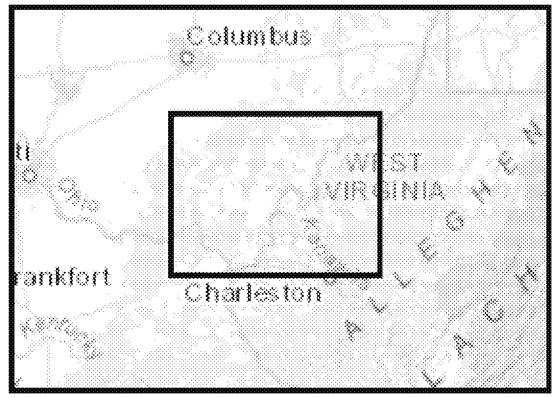




Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

USGS Groundwater Monitoring Wells

Alluvial Aquifer

Conemaugh Group (Sedimentary Aquifer)

Monongahela Group (Sedimentary Aquifer)

NOTES:

1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 2.5 5 10 15 20

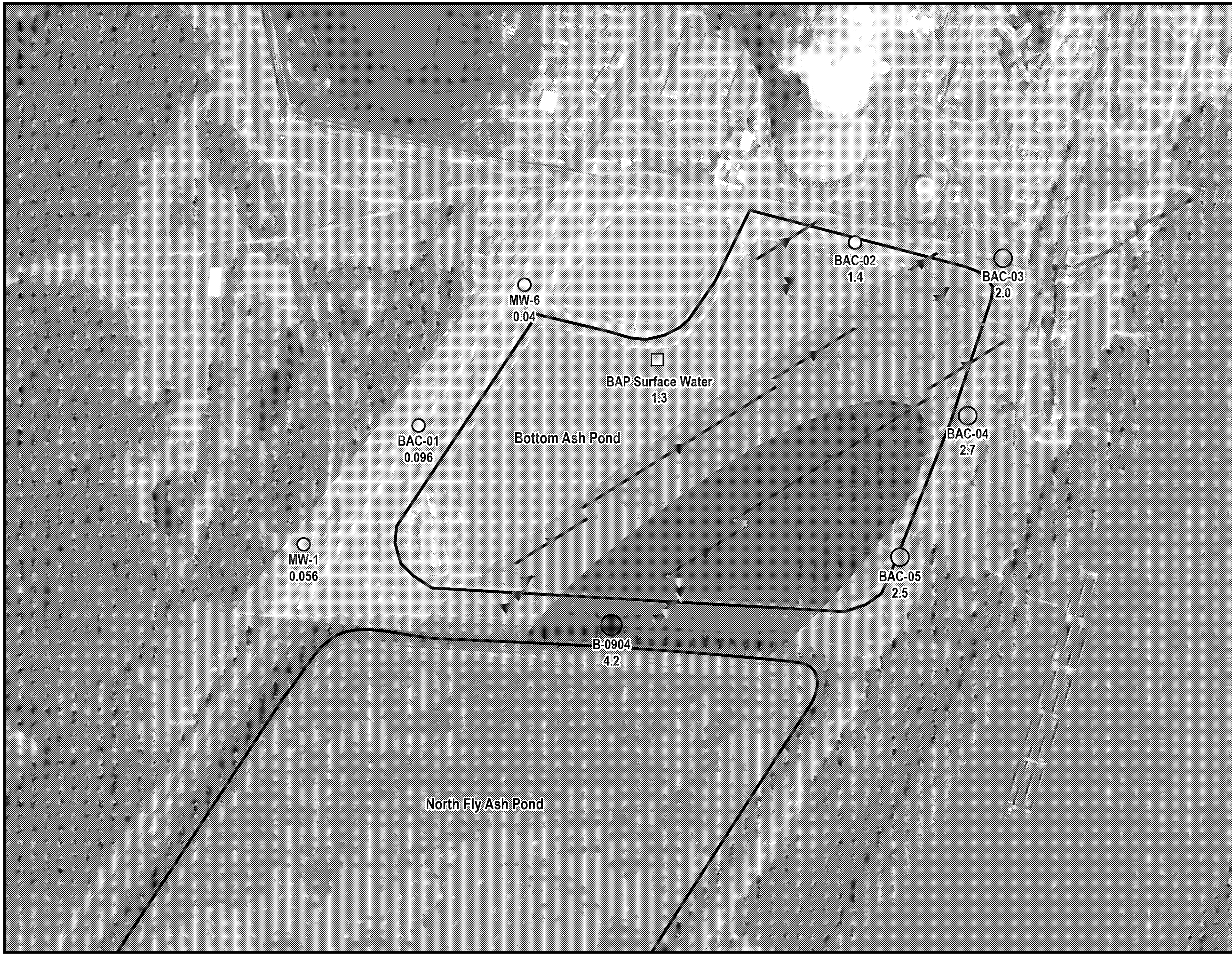
Miles

Figure 4-2: Locations of Background Groundwater Monitoring Wells

Gavin Generating Station

Cheshire, Ohio

ERM



Legend

0.054 Boron Concentration (mg/L)

Low (Typical) River State Groundwater Flow Direction to the Northeast*

High River Stage Groundwater Flow Direction to the Northwest*

Coal Combustion Residuals Unit

Boron Concentration in Groundwater

<2 mg/L

2-3 mg/L

>3 mg/L

Sample Type

Groundwater

Surface Water

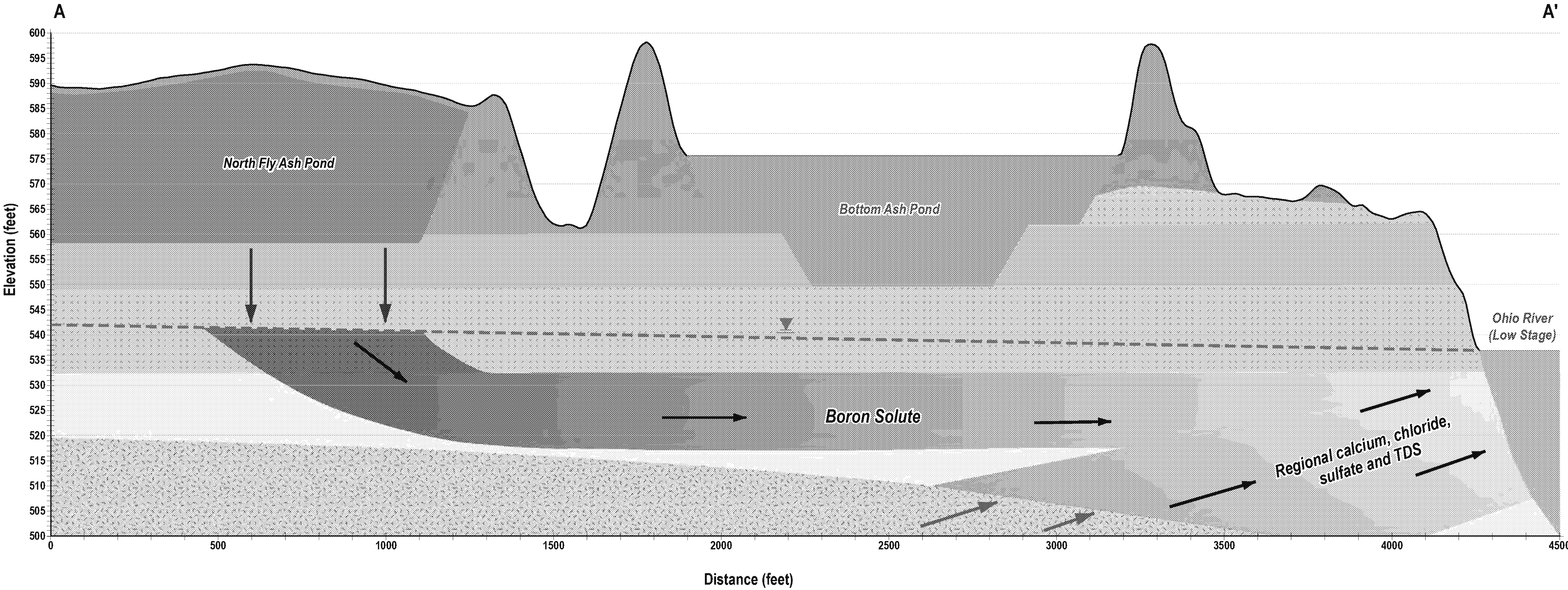
NOTES:
1. Groundwater and surface water data is from September 2019
2. * Arrow length is relative to duration of low, high river stage
3. B-0904 sample was collected in March 2019.

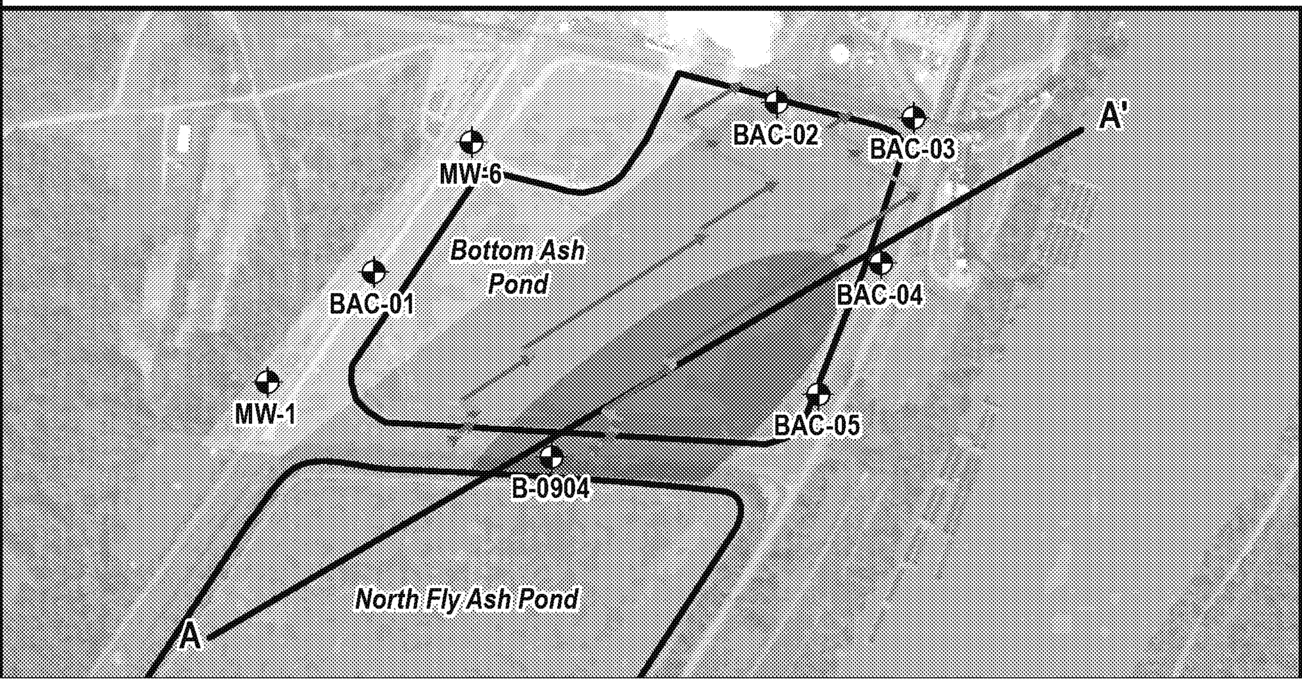
N

0 100 200 300 400 500
Feet

Figure 4-3: Boron Distribution in Groundwater
Data Collected in September 2019
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Monitoring Well
- Cross Section Location
- Interpreted Low River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca^{2+}, Cl^{-}, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM

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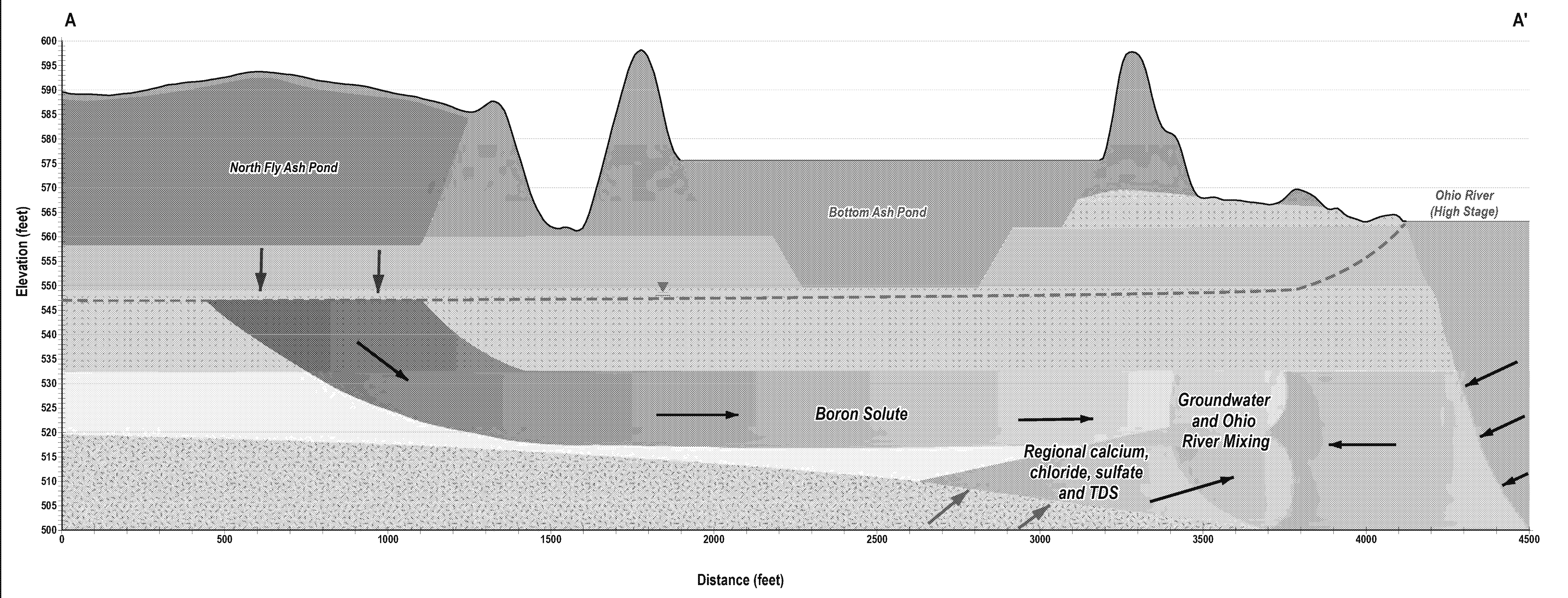

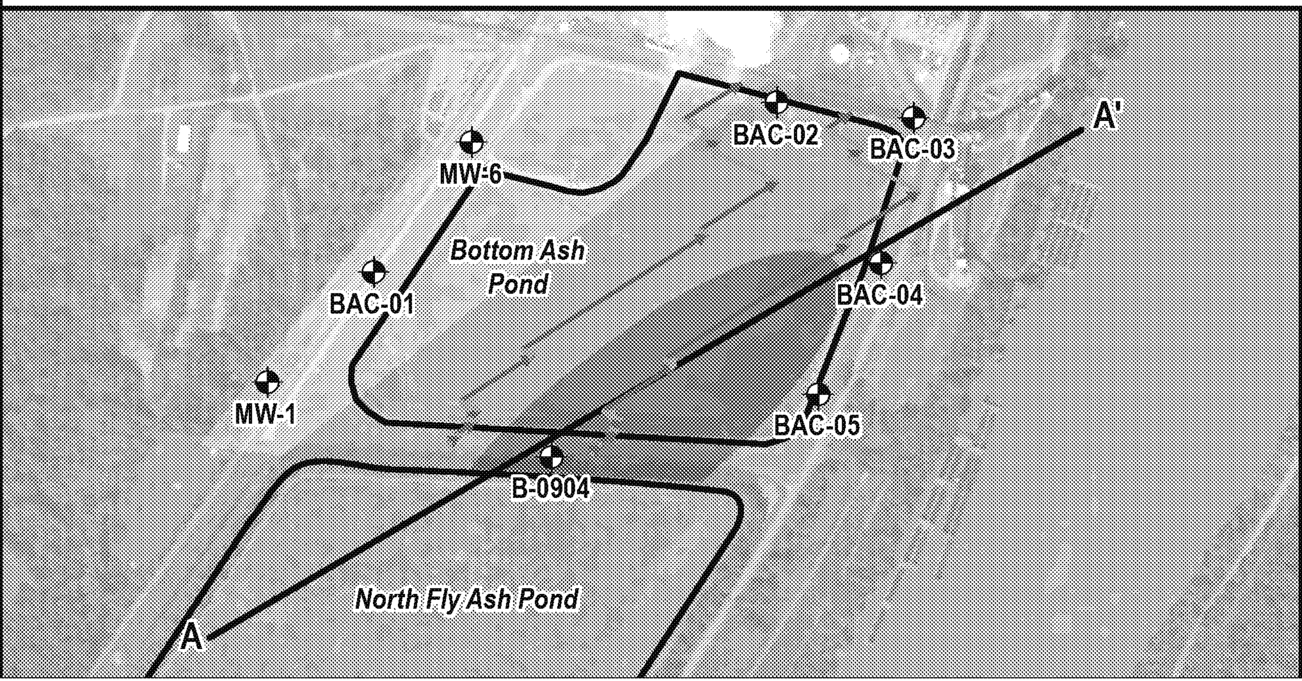

Legend

- Monitoring Well
- Cross Section Location
- Interpreted High River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca^{2+}, Cl^{-}, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-2: High River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM

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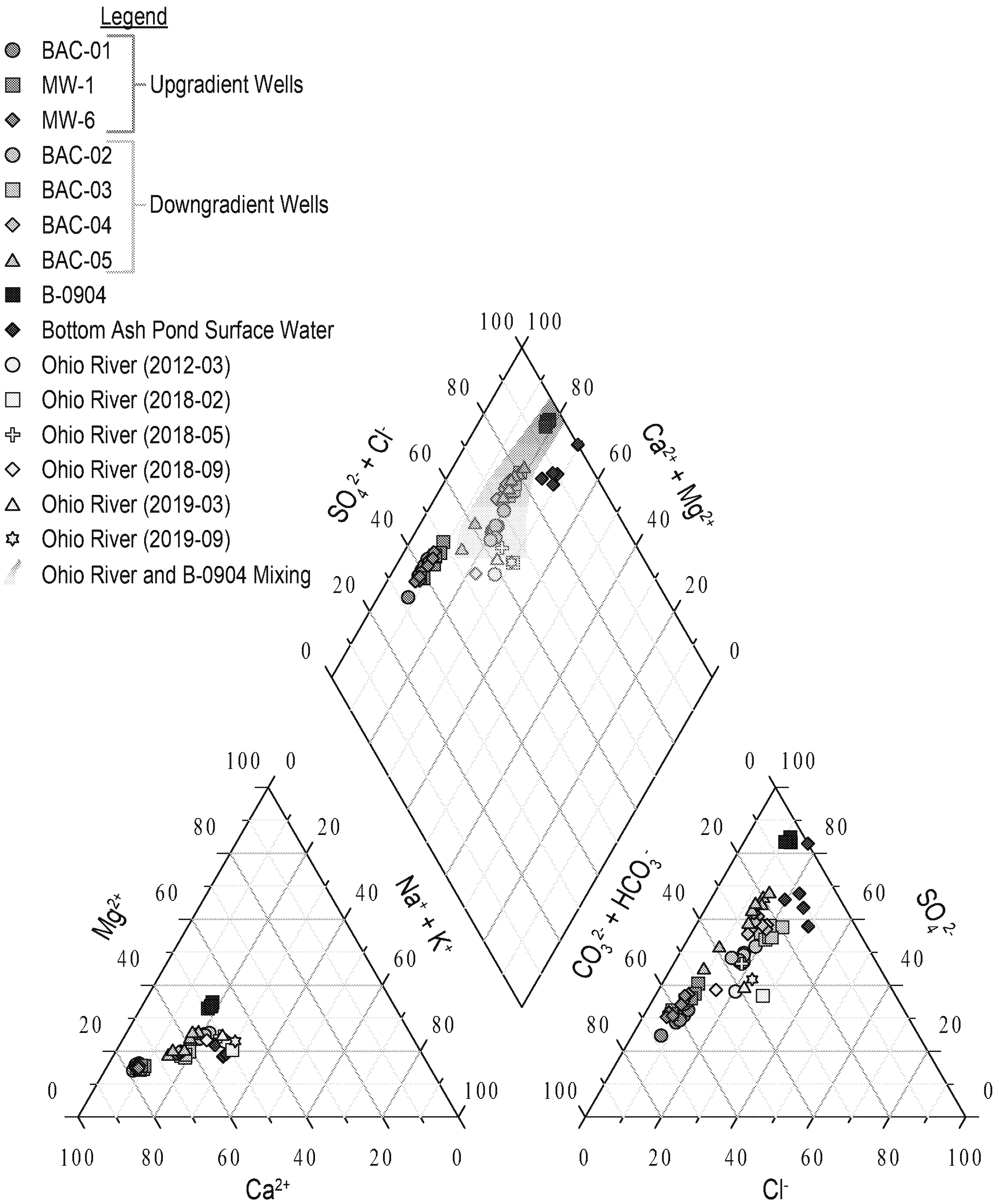

NOTES:
1. Date Range: March 2012 to September 2019
2. Only wells with complete data including all 8 piper diagram analytes are presented

Figure 6-1: BAP Piper Diagram
September 2019
Gavin Generating Station
Cheshire, Ohio

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Hong Kong	South Africa
India	South Korea
Indonesia	Spain
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APPENDIX C ANALYTICAL DATA SUMMARY

Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

Location ID / Date		FEDERAL BAC-01 2016-08-26 N	FEDERAL BAC-01 2016-10-03 N	FEDERAL BAC-01 2016-11-28 N	FEDERAL BAC-01 2017-02-07 N	FEDERAL BAC-01 2017-03-28 N	FEDERAL BAC-01 2017-05-03 N	FEDERAL BAC-01 2017-06-13 N	FEDERAL BAC-01 2017-07-14 N	FEDERAL BAC-01 2018-02-28 N	FEDERAL BAC-01 2018-05-16 N	FEDERAL BAC-01 2018-09-18 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L			222	214						240	210
Aluminum	mg/L					0.49	0.045 J	0.05 U	0.05 U			
Antimony	mg/L	2E-05	2E-05	1E-05	2E-05	0.002 B	0.002 U	0.002 U	0.002 U			
Arsenic	mg/L	0.00078	0.00042	0.0004	0.00106	0.0022 J	0.005 U	0.005 U	0.005 U			
Barium	mg/L	0.0725	0.0611	0.0641	0.0625	0.075 B	0.063	0.064	0.062			
Beryllium	mg/L	1E-05	2E-05	2E-05	9E-06	0.001 U	0.001 U	0.001 U	0.001 U			
Bicarbonate Alkalinity as CaCO3	mg/L									220	240	210
Boron	mg/L	0.104	0.095	0.11	0.162	0.11 J	0.12	0.13 J	0.13 JB	0.12	0.12	0.12
Bromide	mg/L			0.1	0.1	0.19 J	0.16 J	0.15 J	0.16 J			
Cadmium	mg/L	2E-05	2E-05	2E-05	2E-05	0.001 U	0.001 U	0.001 U	0.001 U			
Calcium	mg/L	113	105	114	107	110 JB	100	110	110	110	100	100
Carbonate Alkalinity as CaCO3	mg/L									5	5	5
Chloride	mg/L	20.4	21.5	22.2	23.4	23	22	22	23	23	19	25
Chromium	mg/L	0.0004	0.0002	0.000207	0.000312	0.0013 JB	0.002 U	0.002 U	0.002 U			
Cobalt	mg/L	0.00052	0.000168	0.000164	0.000439	0.00095 J	0.0002 J	0.001 U	0.001 U			
Conductivity, Field	uS/cm	645	646	661	644							
Copper	mg/L					0.0014 JB	0.002 U	0.002 U	0.002 U			
Dissolved Oxygen, Field	mg/L	0.76	0.16	0.78	0.76						0.17	
Dissolved Solids, Total	mg/L	434	402	380	360	420	400	420 J	420 J	410	380	410
Fluoride	mg/L	0.1	0.1	0.1	0.1	0.14	0.14	0.14	0.14	0.12	0.13	0.12
Iron	mg/L					1.4 B	0.16	0.085 J	0.1 U			
Lead	mg/L	0.00244	0.000255	0.000283	0.00058	0.001 J	0.001 U	0.001 U	0.001 U			
Lithium	mg/L	0.008	0.0009	0.006	0.004	0.0034 J	0.0024 J	0.0035 J	0.0038 J			
Magnesium	mg/L			13.4	12.8	12 B	13	14	13	12	12	12
Manganese	mg/L					0.19 JB	0.1	0.048	0.049			
Mercury	mg/L	5E-06	5E-06	5E-06	5E-06	0.0002 U	0.0002 U	0.0002 U	0.0002 U			
Molybdenum	mg/L	0.00037	0.00071	0.00055	0.00147	0.0014 J	0.01 U	0.01 U	0.01 U			
Nickel	mg/L					0.0018 JB	0.002 U	0.002 U	0.002 U			
pH, Field	pH units	6.82	6.83	6.85	6.75	6.82	6.79	6.76	6.67		6.83	6.86
Potassium	mg/L			1.57	1.74	1.6 B	1.4	1.4	1.4	1.6	1.5	1.4
Radium 226	pCi/L	0.244	0.323	0.186	0.173	0.0827 U	0.0201 U	0.418	0.0636 U			
Radium-226/228	pCi/L	0.549	0.526	1.114	0.449	0.316	0.0267 U	0.559	0.195 U			
Radium-228	pCi/L	0.305	0.203	0.928	0.276	0.233 U	0.00664 U	0.141 U	0.131 U			
Redox Potential, Field	mV	148.6	166.8	93	135.6							
Selenium	mg/L	0.0002	0.0002	0.0001	0.0001	0.0011 J	0.005 U	0.005 U	0.005 U			
Silver	mg/L					9.6E-05 J	0.001 U	0.001 U	0.001 U			
Sodium	mg/L			11.6	10.8	10 JB	11 B	11	11 J	11	11	11
Specific Conductivity, Field	uS/cm										621	
Strontium	mg/L			0.19	0.174	0.18 B	0.16 B	0.17 B	0.17			
Sulfate	mg/L	112	105	111	95.3	92	92	95	95	91	84	98
Temperature, Field	deg C	16.2	13.9	13.8	14.4						14.5	
Thallium	mg/L	1E-05	8.4E-05	2E-05	1E-05	0.001 U	0.001 U	0.001 U	0.001 U			
Turbidity, Field	NTU	9.2	5.1	6.1	13.6	18.3	2.1	1.8	0.5		15.3	4.23
Vanadium	mg/L					0.0012 J						
Zinc	mg/L					0.02 U	0.02 U	0.02 U	0.02 U			

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
B: Compound was found in the blank and sample.
J: Result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate
U: Indicates the analyte was analyzed for but not detected.
Empty cells = Not analyzed

Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID Date	FEDERAL BAC-01 2019-03-16 N	FEDERAL BAC-01 2019-09-19 N	FEDERAL BAC-02 2016-08-25 N	FEDERAL BAC-02 2016-10-03 N	FEDERAL BAC-02 2016-11-28 N	FEDERAL BAC-02 2017-02-07 N	FEDERAL BAC-02 2017-03-28 N	FEDERAL BAC-02 2017-05-03 N	FEDERAL BAC-02 2017-06-13 FD	FEDERAL BAC-02 2017-06-13 N	FEDERAL BAC-02 2017-07-19 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L	200	190			285	273					
Aluminum	mg/L							0.15	0.078	0.041 J	0.035 J	0.1
Antimony	mg/L			6E-05	3E-05	4E-05	2E-05	0.00035 JB	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L			0.00159	0.00124	0.00146	0.00067	0.00072 J	0.00075 J	0.005 U	0.00075 J	0.00078 J
Barium	mg/L			0.0515	0.0489	0.0492	0.0358	0.05 B	0.048	0.049	0.051	0.052
Beryllium	mg/L			3.5E-05	2.3E-05	2.6E-05	7E-06	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	200	190									
Boron	mg/L	0.11		1.72	1.92	2.17	2.08	2.5 J	2.4	2.6 J	2.7 J	2.7 JB
Bromide	mg/L					0.624	0.483	0.73	0.12 J	0.74	0.74	0.77
Cadmium	mg/L			0.0003	0.00031	0.0003	0.00025	0.00035 J	0.00032 J	0.00043 J	0.00041 J	0.00036 J
Calcium	mg/L	100		149	156	168	161	170 JB	180	180	180	190
Carbonate Alkalinity as CaCO3	mg/L	5	5 U									
Chloride	mg/L	27	21	82.8	91.8	95	97.3	100	21	110	110	110
Chromium	mg/L			0.0013	0.0008	0.00129	0.00432	0.0012 JB	0.0015 J	0.0016 J	0.002 U	0.0011 J
Cobalt	mg/L			0.00333	0.00257	0.00266	0.00178	0.0019	0.0018	0.0018	0.0017	0.0025
Conductivity, Field	uS/cm			1279	1355	1436	1434					
Copper	mg/L							0.0014 JB	0.002 U	0.002 U	0.002 U	0.002 U
Dissolved Oxygen, Field	mg/L			0.63	0.39	0.94	1.18					
Dissolved Solids, Total	mg/L	390	350	824	858	896	860	1000	1000	1100 J	1000 J	1100 J
Fluoride	mg/L	0.12	0.12	0.19	0.1	0.08	0.17	0.17	0.032 J	0.17	0.17	0.16
Iron	mg/L							0.39 B	0.27	0.15	0.11	0.39
Lead	mg/L			0.00284	0.00184	0.00158	0.000589	0.0008 J	0.00068 J	0.0006 J	0.00068 J	0.00089 J
Lithium	mg/L			0.01	0.004	0.005	0.001	0.0022 J	0.008 U	0.008 U	0.008 U	0.0025 J
Magnesium	mg/L	13				43.9	43.9	46 B	51	51	52	49
Manganese	mg/L							4.1 JB	4.3	4.4	4.5	4.7
Mercury	mg/L			3E-06	7E-06	5E-06	3E-06	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L			0.00109	0.00044	0.00081	0.00201	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	mg/L							0.022 B	0.022	0.02	0.021	0.024
pH, Field	pH units	6.93	6.94	6.2	6.19	6.14	6.1	6.18	6.13		6.08	6.02
Potassium	mg/L	1.6				3.66	3.43	3.6 B	3.7	3.6	3.6	4
Radium 226	pCi/L			0.934	0.233	0.12	0.204	0.0599 U	0.0438 U	0.113	0.072 U	0.0813 U
Radium-226/228	pCi/L			1.073	0.855	0.0347	0.1452	0.298 U	0.375 U	0.29 U	0.305 U	-0.104 U
Radium-228	pCi/L			0.139	0.622	-0.0853	-0.0588	0.238 U	0.331 U	0.177 U	0.233 U	-0.186 U
Redox Potential, Field	mV			112.3	164.6	115.3	143.3					
Selenium	mg/L			0.0003	0.0002	0.0002	6E-05	0.00048 J	0.005 U	0.005 U	0.005 U	0.005 U
Silver	mg/L							0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Sodium	mg/L	11				67.3	64.6	68 JB	74 B	73	74	73 JB
Specific Conductivity, Field	uS/cm											
Strontium	mg/L					0.499	0.479	0.55 B	0.56 B	0.51 B	0.53 B	0.63
Sulfate	mg/L	110	110	288	341	359	346	410	80	430	420	440
Temperature, Field	deg C			19.9	17.2	16	16.2					
Thallium	mg/L			0.000128	3E-05	9.3E-05	3E-05	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Turbidity, Field	NTU		8	8.1	9.6	9.3	5.4	2.2	2.5		2	7.4
Vanadium	mg/L							0.005 U				
Zinc	mg/L							0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

Location ID / Date		FEDERAL BAC-02 2018-02-28 N	FEDERAL BAC-02 2018-05-15 FD	FEDERAL BAC-02 2018-05-15 N	FEDERAL BAC-02 2018-09-18 FD	FEDERAL BAC-02 2018-09-18 N	FEDERAL BAC-02 2019-03-16 N	FEDERAL BAC-02 2019-09-18 N	FEDERAL BAC-03 2016-08-26 N	FEDERAL BAC-03 2016-10-03 N	FEDERAL BAC-03 2016-11-28 N	FEDERAL BAC-03 2017-02-07 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L		300	310	280	280	290	250			96.6	88.2
Aluminum	mg/L											
Antimony	mg/L								5E-05	2E-05	2E-05	3E-05
Arsenic	mg/L								0.00027	0.00024	0.00016	0.00031
Barium	mg/L								0.0469	0.045	0.0422	0.0426
Beryllium	mg/L								1E-05	2E-05	2E-05	8E-06
Bicarbonate Alkalinity as CaCO3	mg/L	260	300	310	280	280	290	250				
Boron	mg/L	2	2.3	2.4	2.5	2.5	2.3		2.14	2.06	2.07	2.24
Bromide	mg/L										0.151	0.1
Cadmium	mg/L								0.00015	9E-05	8E-05	8E-05
Calcium	mg/L	160	160	170	170	160	150		97.8	93.7	90.4	95.7
Carbonate Alkalinity as CaCO3	mg/L	5	5	5	5	5	5	5 U				
Chloride	mg/L	97	110	110	100	100	96	68	52.1	52.8	48.2	52.2
Chromium	mg/L								0.0007	0.0006	0.000458	0.00115
Cobalt	mg/L								0.000468	0.00026	0.000169	0.000317
Conductivity, Field	uS/cm								767	752	749	762
Copper	mg/L											
Dissolved Oxygen, Field	mg/L			0.26					1.1	0.2	0.68	0.83
Dissolved Solids, Total	mg/L	900	950	980	970	980	920	580	528	476	416	514
Fluoride	mg/L	0.16	0.16	0.16	0.16	0.2	0.15	0.15	0.07	0.09	0.07	0.07
Iron	mg/L											
Lead	mg/L								0.00184	0.000641	0.00048	0.00168
Lithium	mg/L								0.009	0.006	0.007	0.006
Magnesium	mg/L	41	44	47	44	45	44				16.2	17.6
Manganese	mg/L											
Mercury	mg/L								5E-06	1.6E-05	5E-06	5E-06
Molybdenum	mg/L								0.00031	0.00138	0.0005	0.0006
Nickel	mg/L											
pH, Field	pH units			6.18		6.2	6.33	6.43	6.12	6.03	6.04	6.05
Potassium	mg/L	3.8	3.8	3.9	3.6	3.6	3.8				1.9	2.12
Radium 226	pCi/L								0.0989	0.13	0.0518	0.281
Radium-226/228	pCi/L								0.2129	-0.14	0.3818	0.17
Radium-228	pCi/L								0.114	-0.27	0.33	-0.111
Redox Potential, Field	mV								213.7	236.8	192.3	248.5
Selenium	mg/L								7E-05	6E-05	0.0001	4E-05
Silver	mg/L											
Sodium	mg/L	63	66	70	68	68	69				30.5	31.2
Specific Conductivity, Field	uS/cm			1469								
Strontium	mg/L										0.211	0.222
Sulfate	mg/L	360	390	390	390	400	370	310	211	204	200	196
Temperature, Field	deg C			17.5					18.6	15.4	14.5	14.8
Thallium	mg/L								3E-05	2E-05	1E-05	3E-05
Turbidity, Field	NTU			17.3		2.02		5	3.9	8.1	7.6	5.1
Vanadium	mg/L											
Zinc	mg/L											

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
B: Compound was found in the blank and sample.
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID Date	FEDERAL BAC-03 2017-03-28 N	FEDERAL BAC-03 2017-05-02 FD	FEDERAL BAC-03 2017-05-02 N	FEDERAL BAC-03 2017-06-13 N	FEDERAL BAC-03 2017-07-14 N	FEDERAL BAC-03 2018-02-28 N	FEDERAL BAC-03 2018-05-15 N	FEDERAL BAC-03 2018-09-18 N	FEDERAL BAC-03 2019-03-16 N	FEDERAL BAC-03 2019-09-19 N	FEDERAL BAC-04 2016-08-26 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L							100	93	91	85	
Aluminum	mg/L	0.059	0.049 J	0.042 J	0.05 U	0.05 U						
Antimony	mg/L	0.00048 JB	0.002 U	0.002 U	0.002 U	0.002 U						9E-05
Arsenic	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U						0.00183
Barium	mg/L	0.05 B	0.048	0.048	0.045	0.044						0.0624
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						2E-05
Bicarbonate Alkalinity as CaCO3	mg/L						90	100	93	91	85	
Boron	mg/L	2.3 J	2.1	2.1	2 J	2 JB	2.3	2.5	2.2	2.2		2.56
Bromide	mg/L	0.17 J	0.15 J	0.15 J		0.16 J						
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						0.00011
Calcium	mg/L	97 JB	96	96	89	88	95	96	92	91		99.1
Carbonate Alkalinity as CaCO3	mg/L						5	5	5	5	5 U	
Chloride	mg/L	68	72	72	62	61	62	56	57	59	52	42.6
Chromium	mg/L	0.00054 JB	0.002 U	0.002 U	0.002 U	0.002 U						0.0006
Cobalt	mg/L	0.00027 J	0.00024 J	0.00025 J	0.001 U	0.001 U						0.00807
Conductivity, Field	uS/cm											696
Copper	mg/L	0.0031 B	0.002 B	0.0019 JB	0.0017 JB	0.002 U						
Dissolved Oxygen, Field	mg/L							0.15				0.77
Dissolved Solids, Total	mg/L	520	510	510	500 J	500 J	500	540	500	480	480	516
Fluoride	mg/L	0.071	0.071	0.071	0.071	0.07	0.072	0.085	0.073	0.12	0.062	0.08
Iron	mg/L	0.14 B	0.13	0.1	0.1 U	0.1 U						
Lead	mg/L	0.00093 J	0.00096 J	0.00083 J	0.00055 J	0.001 U						0.00106
Lithium	mg/L	0.0056 J	0.0049 J	0.0049 J	0.0033 J	0.0067 J						0.007
Magnesium	mg/L	17 B	18	18	17	17	17	17	16	18		
Manganese	mg/L	0.24 JB	0.23	0.22	0.19	0.15						
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U						5E-06
Molybdenum	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U						0.00057
Nickel	mg/L	0.0044 B	0.0042	0.048	0.0035	0.0035						
pH, Field	pH units	6.07		6.05	5.89	5.93		6.16	6.12	6.26	6.19	6.41
Potassium	mg/L	1.9 B	1.9	1.9	1.8	1.8	1.8	1.7	1.8	2		
Radium 226	pCi/L	0.0181 U	0.065 U	-0.0333 U	0.0442 U	0.235						0.764
Radium-226/228	pCi/L	0.102 U	0.345	0.271 U	0.0882 U	0.506						0.8152
Radium-228	pCi/L	0.0838 U	0.28 U	0.304 U	0.044 U	0.272						0.0512
Redox Potential, Field	mV											330.2
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.0011 JB						0.0001
Silver	mg/L	3.3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U						
Sodium	mg/L	31 JB	34 B	34 B	33	34 J	31	30	31	32		
Specific Conductivity, Field	uS/cm							731				
Strontium	mg/L	0.22 B	0.22 B	0.22 B	0.2 B	0.21						
Sulfate	mg/L	180	180	180	190	190 J	210	200	200	200	210	215
Temperature, Field	deg C							16.5				19.35
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						7.2E-05
Turbidity, Field	NTU	2.1		4.2	2.3	1.9		1.03	1.36		2	9.1
Vanadium	mg/L	0.005 U										
Zinc	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U						

Notes:
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID Date	FEDERAL BAC-04 2016-10-03 N	FEDERAL BAC-04 2016-11-28 N	FEDERAL BAC-04 2017-02-07 N	FEDERAL BAC-04 2017-03-28 N	FEDERAL BAC-04 2017-05-02 N	FEDERAL BAC-04 2017-06-13 N	FEDERAL BAC-04 2017-07-19 N	FEDERAL BAC-04 2018-03-01 FD	FEDERAL BAC-04 2018-03-01 N	FEDERAL BAC-04 2018-05-15 N	FEDERAL BAC-04 2018-09-18 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L		107	111					92	91	96	91
Aluminum	mg/L				0.041 J	0.76	0.63	1.6				
Antimony	mg/L	7E-05	4E-05	7E-05	0.00046 JB	0.002 U	0.00071 J	0.002 U				
Arsenic	mg/L	0.00134	0.00212	0.0017	0.002 J	0.0033 J	0.0045 J	0.0086				
Barium	mg/L	0.0583	0.059	0.0597	0.06 B	0.07	0.065	0.077				
Beryllium	mg/L	6E-06	9E-06	2.1E-05	0.001 U	0.001 U	0.00059 J	0.001 U				
Bicarbonate Alkalinity as CaCO3	mg/L								92	91	96	91
Boron	mg/L	2.53	2.61	2.7	2.7 J	2.5	2.7 J	2.5 JB	2.8	2.8	2.9	2.8
Bromide	mg/L		0.1	0.1		0.17 J	0.16 J	0.17 J				
Cadmium	mg/L	4E-05	2E-05	9E-05	0.001 U	0.001 U	0.00036 J	0.00022 J				
Calcium	mg/L	98.2	96.7	99.6	94 JB	94	83	86	94	94	95	92
Carbonate Alkalinity as CaCO3	mg/L								5	5	5	5
Chloride	mg/L	44.5	40.9	40		48	47	49	52	52	49	40
Chromium	mg/L	0.0009	0.000238	0.00081	0.00034 JB	0.005	0.0029	0.0039				
Cobalt	mg/L	0.00627	0.00577	0.00553	0.0066	0.0083	0.0087	0.0095				
Conductivity, Field	uS/cm	761	751	765								
Copper	mg/L				0.00037 JB	0.0088 B	0.0055 B	0.0064				
Dissolved Oxygen, Field	mg/L	0.4	0.67	0.98							0.93	
Dissolved Solids, Total	mg/L	488	448	498		530	520 J	520 J	500	490	540	490
Fluoride	mg/L	0.09	0.08	0.09		0.11	0.079	0.077	0.087	0.084	0.085	0.082
Iron	mg/L				1.8 B	3.8	4.6	8.7				
Lead	mg/L	0.000367	0.000277	0.00102	0.00037 J	0.0035	0.0037	0.0064				
Lithium	mg/L	0.006	0.01	0.006	0.0067 J	0.0068 J	0.0048 J	0.0082				
Magnesium	mg/L		17.7	18	18 B	19	18	17	18	18	18	17
Manganese	mg/L				1.4 JB	2	1.4	1.4				
Mercury	mg/L	1.9E-05	5E-06	5E-06	0.0002 U	0.0002 U	0.0002 U	0.0002 U				
Molybdenum	mg/L	0.00465	0.00037	0.00365	0.00061 J	0.01 U	0.01 U	0.01 U				
Nickel	mg/L				0.012 B	0.013	0.0088	0.012				
pH, Field	pH units	6.17	6.19	6.23	6.18	6.2	6.04	5.94			6.17	6.24
Potassium	mg/L		1.95	2	1.9 B	2	1.8	2.1	1.8	1.8	1.8	1.8
Radium 226	pCi/L	0.226	0.235	0.19		0.17	0.152	0.274				
Radium-226/228	pCi/L	0.467	0.34	0.017		0.641	0.178 U	0.576				
Radium-228	pCi/L	0.241	0.105	-0.173		0.47	0.0263 U	0.302 U				
Redox Potential, Field	mV	59.6	24	24.3								
Selenium	mg/L	6E-05	8E-05	0.0001	0.005 U	0.005 U	0.005 U	0.005 U				
Silver	mg/L				0.00011 J	0.002	0.00026 J	0.00042 J				
Sodium	mg/L		28.7	27.9	27 JB	29 B	27	27 JB	29	28	28	27
Specific Conductivity, Field	uS/cm										721	
Strontium	mg/L		0.218	0.218	0.21 B	0.21 B	0.16 B	0.19				
Sulfate	mg/L	214	209	200		220 J	230	220	210	220	220	220
Temperature, Field	deg C	16.6	15.1	15							19.6	
Thallium	mg/L	4E-05	3E-05	5.3E-05	0.001 U	0.001 U	0.001 U	0.001 U				
Turbidity, Field	NTU	5	9	9.2	0.8	44.7	58.9	108.1			33.2	21.5
Vanadium	mg/L											
Zinc	mg/L				0.02 U	0.016 J	0.02 U	0.016 J				

Notes:
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deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
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B: Compound was found in the blank and sample.
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID Date	FEDERAL BAC-04 2019-03-16 FD	FEDERAL BAC-04 2019-03-16 N	FEDERAL BAC-04 2019-09-18 FD	FEDERAL BAC-04 2019-09-18 N	FEDERAL BAC-05 2016-08-26 N	FEDERAL BAC-05 2016-10-03 N	FEDERAL BAC-05 2016-11-28 N	FEDERAL BAC-05 2017-02-07 N	FEDERAL BAC-05 2017-03-28 N	FEDERAL BAC-05 2017-05-03 N	FEDERAL BAC-05 2017-06-13 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L	100	100	96	96			144	105			
Aluminum	mg/L									0.11	0.17	0.43
Antimony	mg/L					0.00023	7E-05	9E-05	3E-05	0.00048 JB	0.00057 J	0.002 U
Arsenic	mg/L					0.00298	0.00143	0.00177	0.00065	0.00086 J	0.00097 J	0.0013 J
Barium	mg/L					0.0585	0.0478	0.0459	0.0495	0.04 B	0.052	0.039
Beryllium	mg/L					0.000118	4.7E-05	5.9E-05	1E-05	0.001 U	0.001 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	100	100	96	96							
Boron	mg/L	3	2.9			3.32	3.72	3.99	2.78	4.5 J	3.2	4.5 J
Bromide	mg/L							0.09	0.1	0.13 J	0.14 J	0.1 J
Cadmium	mg/L					0.00033	9E-05	5E-05	8E-05	0.001 U	0.001 U	0.001 U
Calcium	mg/L	95	96			93.4	90.8	97.7	89	94 JB	100	90
Carbonate Alkalinity as CaCO3	mg/L	5	5	5 U	5 U							
Chloride	mg/L	41	41	37	37	31.6	28.5	24.6	36.2	24	34	21
Chromium	mg/L					0.0048	0.0018	0.00208	0.000652	0.0016 JB	0.0013 J	0.0027
Cobalt	mg/L					0.0111	0.00814	0.00536	0.00852	0.004	0.0078	0.0042
Conductivity, Field	uS/cm					730	706	702	751			
Copper	mg/L									0.0013 JB	0.002 U	0.0023 B
Dissolved Oxygen, Field	mg/L					3.43	1.19	0.59	0.86			
Dissolved Solids, Total	mg/L	520	520	470	480	522	468	452	494	480	540	460 J
Fluoride	mg/L	0.082	0.078	0.082	0.08	0.1	0.15	0.17	0.1	0.21	0.17	0.22
Iron	mg/L									0.63 B	0.78	1.7
Lead	mg/L					0.0066	0.00248	0.0021	0.000631	0.0008 J	0.0012	0.0019
Lithium	mg/L					0.015	0.007	0.01	0.006	0.0042 J	0.0048 J	0.0021 J
Magnesium	mg/L	18	18					16.9	17.9	16 B	20	16
Manganese	mg/L									3.4 JB	7.7	3
Mercury	mg/L					3E-06	1.4E-05	3E-06	5E-06	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L					0.00147	0.00118	0.00139	0.00237	0.0011 J	0.01 U	0.01 U
Nickel	mg/L									0.0095 B	0.02	0.008
pH, Field	pH units		6.46		6.39	6.58	6.63	6.64	6.2	6.72	6.47	6.63
Potassium	mg/L	1.9	2					1.7	1.7	1.4 B	1.6	1.4
Radium 226	pCi/L					0.41	1.12	0.378	0.0928	0.123	-0.0279 U	0.0494 U
Radium-226/228	pCi/L					0.127	2.056	0.554	0.2258	0.241 U	0.253 U	0.0636 U
Radium-228	pCi/L					-0.283	0.936	0.176	0.133	0.118 U	0.281 U	0.0142 U
Redox Potential, Field	mV					9.9	111.5	14	68.6			
Selenium	mg/L					0.0004	0.0002	0.0002	4E-05	0.005 U	0.0011 J	0.005 U
Silver	mg/L									0.0011	5.7E-05 J	0.00011 J
Sodium	mg/L	28	28					22.9	28.3	21 JB	28 B	22
Specific Conductivity, Field	uS/cm											
Strontium	mg/L							0.16	0.162	0.15 B	0.17 B	0.13 B
Sulfate	mg/L	220	220	230	230	200	190	184	216	170	220 J	170
Temperature, Field	deg C					20.4	18.5	15.4	15.5			
Thallium	mg/L					7.3E-05	5E-05	4E-05	5.4E-05	0.001 U	0.001 U	0.001 U
Turbidity, Field	NTU				28	96.7	72.3	50.1	7.8	6.2	5.3	26.6
Vanadium	mg/L									0.005 U		
Zinc	mg/L									0.015 J	0.02 U	0.015 J

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

Analyte	Unit	FEDERAL BAC-05 2017-07-19 N	FEDERAL BAC-05 2018-03-01 N	FEDERAL BAC-05 2018-05-16 N	FEDERAL BAC-05 2018-06-20 N	FEDERAL BAC-05 2018-09-18 N	FEDERAL BAC-05 2019-03-16 N	FEDERAL BAC-05 2019-09-18 N	FEDERAL B-0904 2018-03-01 N	FEDERAL B-0904 2018-04-11 N	FEDERAL B-0904 2018-05-16 N	FEDERAL B-0904 2018-09-18 N
Alkalinity, Total as CaCO3	mg/L		160	90	65	79	64	84	12		11	9.4
Aluminum	mg/L	0.43								0.14		
Antimony	mg/L	0.002 U								0.002		
Arsenic	mg/L	0.00084 J								0.005		
Barium	mg/L	0.041								0.018		
Beryllium	mg/L	0.001 U								0.001		
Bicarbonate Alkalinity as CaCO3	mg/L		160	90	65	79	64	84	12		11	9.4
Boron	mg/L	4.3 JB	3.9	2.9	2.8	2.8	2.5		3.7	4.1	4	4
Bromide	mg/L	0.1 J								0.14		
Cadmium	mg/L	0.001 U								0.00098		
Calcium	mg/L	87	84	74	70	76	70		47	52	47	45
Carbonate Alkalinity as CaCO3	mg/L		5	5	5	5	5	5 U	5		5	5
Chloride	mg/L	21	21	32	31	37	37	32	24	21	20	21
Chromium	mg/L	0.0092								0.002		
Cobalt	mg/L	0.0037								0.0035		
Conductivity, Field	uS/cm											
Copper	mg/L	0.0042								0.002		
Dissolved Oxygen, Field	mg/L			0.5							0.92	
Dissolved Solids, Total	mg/L	460 J	420	470	470	480	470	450	390	360	360	380
Fluoride	mg/L	0.21	0.22	0.11	0.091	0.092	0.084	0.094	0.052	0.03	0.052	0.06
Iron	mg/L	1.4								0.64		
Lead	mg/L	0.0015								0.001		
Lithium	mg/L	0.0045 J								0.0078		
Magnesium	mg/L	15	16	18	19	19	20		21	19	19	19
Manganese	mg/L	2								1.4		
Mercury	mg/L	0.0002 U								0.0002		
Molybdenum	mg/L	0.01 U								0.005		
Nickel	mg/L	0.012								0.035		
pH, Field	pH units	6.53		6.06		6.09	6.1	6.31			5.04	5.08
Potassium	mg/L	1.5	1.4	1.6	1.7	1.6	1.8		0.79	0.44	0.46	0.72
Radium 226	pCi/L	0.0901 U								0.13		
Radium-226/228	pCi/L	0.13 U								0.489		
Radium-228	pCi/L	0.0398 U								0.359		
Redox Potential, Field	mV											
Selenium	mg/L	0.005 U								0.0012		
Silver	mg/L	0.00013 J								6.6E-05		
Sodium	mg/L	21 JB	21	25	25	25	26		20	20	19	19
Specific Conductivity, Field	uS/cm			673							511	
Strontium	mg/L	0.13								0.14		
Sulfate	mg/L	160	150	220	210	230	240	230	220	200	190	210
Temperature, Field	deg C			16.6							13.9	
Thallium	mg/L	0.001 U								0.001		
Turbidity, Field	NTU	25.1		21.3		16.1		37			18.1	36.1
Vanadium	mg/L											
Zinc	mg/L	0.031								0.015		

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
B: Compound was found in the blank and sample.
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID Date	FEDERAL B-0904 2019-03-16 N	FEDERAL GV-0905D 2018-03-01 N	FEDERAL GV-0905D 2018-05-16 N	FEDERAL GV-0905D 2018-09-18 N	FEDERAL GV-0905D 2019-03-16 N	FEDERAL MW-1 2016-08-25 N	FEDERAL MW-1 2016-10-03 N	FEDERAL MW-1 2016-11-28 N	FEDERAL MW-1 2017-02-07 N	FEDERAL MW-1 2017-03-28 FD	FEDERAL MW-1 2017-03-28 N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L	15	62	72	94	79			249	245		
Aluminum	mg/L										0.068	0.092
Antimony	mg/L						2E-05	2E-05	2E-05	2E-05	0.00063 JB	0.0006 JB
Arsenic	mg/L						0.00102	0.00087	0.00073	0.00087	0.00061 J	0.00064 J
Barium	mg/L						0.0982	0.0914	0.0985	0.0899	0.1 B	0.1 B
Beryllium	mg/L						2E-05	1E-05	6E-06	7E-06	0.001 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	15	62	72	94	79						
Boron	mg/L	4.2	0.14	0.14	0.16	0.11	0.053	0.044	0.058	0.048	0.074 J	0.081 J
Bromide	mg/L								0.119	0.099	0.14 J	0.14 J
Cadmium	mg/L						2E-05	1E-05	5E-06	8E-06	0.001 U	0.001 U
Calcium	mg/L	49	78	82	83	83	114	113	124	121	120 JB	120 JB
Carbonate Alkalinity as CaCO3	mg/L	5	5	5	5	5						
Chloride	mg/L	20	120	47	48	48	19.4	19.9	19.5	20	20	20
Chromium	mg/L						0.0007	0.0003	0.000175	0.000219	0.00027 JB	0.00049 JB
Cobalt	mg/L						0.000964	0.000769	0.000672	0.000763	0.0007 J	0.00072 J
Conductivity, Field	uS/cm						714	712	717	707		
Copper	mg/L										0.002 U	0.00074 JB
Dissolved Oxygen, Field	mg/L						0.57	0.54	0.75	0.75		
Dissolved Solids, Total	mg/L	360	490	500	570	530	466	440	447	455	460	470
Fluoride	mg/L	0.04	0.046	0.052	0.061	0.043	0.09	0.09	0.01	0.1	0.11	0.11
Iron	mg/L										0.24 B	0.27 B
Lead	mg/L						0.000495	0.000355	0.000124	0.000214	0.00031 J	0.00035 J
Lithium	mg/L						0.008	0.004	0.006	0.006	0.0041 J	0.004 J
Magnesium	mg/L	21	15	15	14	15			14.1	14.2	13 B	13 B
Manganese	mg/L										0.48 JB	0.48 JB
Mercury	mg/L						5E-06	1.3E-05	5E-06	5E-06	0.0002 U	0.0002 U
Molybdenum	mg/L						0.00045	0.00023	0.00022	0.00042	0.01 U	0.01 U
Nickel	mg/L										0.00053 JB	0.00068 JB
pH, Field	pH units	5.22			5.82	5.85	7.21	7.2	7.16	7.09		7.16
Potassium	mg/L	0.63	1.6	1.5	1.7	1.8			1.57	1.82	1.4 B	1.4 B
Radium 226	pCi/L						1.63	0.285	0.309	0.248	0.119 U	0.209
Radium-226/228	pCi/L						2.081	2.045	0.2551	0.918	0.567	0.537
Radium-228	pCi/L						0.451	1.76	-0.0539	0.67	0.449	0.328 U
Redox Potential, Field	mV						-85.8	-29.2	-37.6	-37.5		
Selenium	mg/L						0.0001	7E-05	4E-05	5E-05	0.005 U	0.005 U
Silver	mg/L										0.00014 J	0.00025 J
Sodium	mg/L	21	59	49	60	54			16	13.5	15 JB	15 JB
Specific Conductivity, Field	uS/cm											
Strontium	mg/L								0.218	0.219	0.2 B	0.2 B
Sulfate	mg/L	210	160	210	230	220	125	126	127	119	120	120
Temperature, Field	deg C						15.1	13.7	12.6	12.9		
Thallium	mg/L						3E-05	2E-05	1E-05	3E-05	0.001 U	0.001 U
Turbidity, Field	NTU				5.59		8.6	7	9	8.8		2.9
Vanadium	mg/L										0.005 U	0.005 U
Zinc	mg/L										0.02 U	0.02 U

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-1	FEDERAL MW-6	FEDERAL MW-6
	Date	2017-05-03	2017-06-13	2017-07-14	2017-07-14	2018-02-28	2018-05-15	2018-09-18	2019-03-16	2019-09-17	2016-08-26	2016-10-03
		N	N	FD	N	N	N	N	N	N	N	N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L						230	220	220	220		
Aluminum	mg/L	0.085	0.061	0.05 U	0.05 U							
Antimony	mg/L	0.002 U	0.002 U	0.002 U	0.002 U						2E-05	5E-05
Arsenic	mg/L	0.005 U	0.005 U	0.005 U	0.00094 J						0.00029	0.00035
Barium	mg/L	0.1	0.11	0.1	0.1						0.148	0.138
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U						2E-05	2E-05
Bicarbonate Alkalinity as CaCO3	mg/L					220	230	220	220	220		
Boron	mg/L	0.06 J	0.066 J	0.067 JB	0.068 JB	0.054	0.054	0.076	0.054		0.045	0.054
Bromide	mg/L	0.12 J	0.13 J	0.13 J	0.13 J							
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U						4E-05	3E-05
Calcium	mg/L	120	120	120	120	120	120	120	120		123	116
Carbonate Alkalinity as CaCO3	mg/L					5	5	5	5	5 U		
Chloride	mg/L	21	22	22	22	24	25	27	30	28	17.1	17.8
Chromium	mg/L	0.002 U	0.002 U	0.002 U	0.002 U						0.0005	0.0001
Cobalt	mg/L	0.00072 J	0.0007 J	0.00069 J	0.00078 J						0.000403	0.000377
Conductivity, Field	uS/cm										716	718
Copper	mg/L	0.002 U	0.002 U	0.002 U	0.002 U							
Dissolved Oxygen, Field	mg/L						0.12				0.04	0.3
Dissolved Solids, Total	mg/L	470	490 J	470 J	480 J	470	500	490	520	510	476	434
Fluoride	mg/L	0.11	0.11	0.11	0.11	0.11	0.11	0.1	0.093	0.098	0.08	0.09
Iron	mg/L	0.3	0.24	0.093 J	0.095 J							
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.00076 J						3.9E-05	2E-05
Lithium	mg/L	0.0033 J	0.0046 J	0.0052 J	0.0051 J						0.007	0.003
Magnesium	mg/L	14	14	14	13	14	14	14	15			
Manganese	mg/L	0.5	0.51	0.49	0.47							
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U						5E-06	2E-06
Molybdenum	mg/L	0.01 U	0.01 U	0.01 U	0.01 U						0.00073	0.00069
Nickel	mg/L	0.002 U	0.002 U	0.002 U	0.002 U							
pH, Field	pH units	7.15	7.13		6.98		7.14	7.16	7.35	7.29	7	7.04
Potassium	mg/L	1.4	1.4	1.4	1.4	1.5	1.4	1.5	1.6			
Radium 226	pCi/L	0.179	0.069 U	0.17	0.258						0.87	0.444
Radium-226/228	pCi/L	0.527	0.525	0.342	0.518						1.663	1.32
Radium-228	pCi/L	0.348 U	0.456	0.171 U	0.259 U						0.793	0.876
Redox Potential, Field	mV										165.3	171
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.0012 JB						3E-05	0.0001
Silver	mg/L	0.00021 J	0.00019 J	0.001 U	0.001 U							
Sodium	mg/L	16 B	15	16 J	15 J	15	17	15	17			
Specific Conductivity, Field	uS/cm						717					
Strontium	mg/L	0.2 B	0.2 B	0.2	0.2							
Sulfate	mg/L	130	130	130	130	140	140	140	150	140	131	123
Temperature, Field	deg C						14.1				17.2	14.7
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U						2E-05	4E-05
Turbidity, Field	NTU	3.3	3		0.6		11.3	2.72		4	5.5	1.9
Vanadium	mg/L											
Zinc	mg/L	0.02 U	0.02 U	0.02 U	0.02 U							

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
B: Compound was found in the blank and sample.
J: Result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate
U: Indicates the analyte was analyzed for but not detected.
Empty cells = Not analyzed

Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Location ID	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6	FEDERAL MW-6
	Date	2016-11-28	2017-02-07	2017-03-28	2017-05-03	2017-06-13	2017-07-14	2018-02-28	2018-05-16	2018-09-18	2019-03-16	2019-09-18
		N	N	N	N	N	N	N	N	N	N	N
Analyte	Unit											
Alkalinity, Total as CaCO3	mg/L	259	257						250	220	230	220
Aluminum	mg/L			0.05 U	0.05 U	0.05 U	0.05 U					
Antimony	mg/L	5E-05	1E-05	0.00059 JB	0.002 U	0.002 U	0.002 U					
Arsenic	mg/L	0.00031	0.00031	0.00042 J	0.005 U	0.005 U	0.005 U					
Barium	mg/L	0.141	0.123	0.15 B	0.15	0.14	0.14					
Beryllium	mg/L	2E-05	2E-05	0.001 U	0.001 U	0.001 U	0.001 U					
Bicarbonate Alkalinity as CaCO3	mg/L							240	250	220	230	220
Boron	mg/L	0.045	0.122	0.065 J	0.06 J	0.067 J	0.064 JB	0.075	0.08	0.073	0.059	
Bromide	mg/L	0.107	0.3	0.14 J	0.12 J	0.12 J	0.12 J					
Cadmium	mg/L	3E-05	3E-05	0.001 U	0.001 U	0.001 U	0.001 U					
Calcium	mg/L	123	106	120 JB	120	120	120	120	120	120	120	
Carbonate Alkalinity as CaCO3	mg/L							5	5	5	5	5 U
Chloride	mg/L	18	17.9	19	20	20	20	22	22	23	23	22
Chromium	mg/L	0.000822	0.00476	0.001 JB	0.002 U	0.002 U	0.002 U					
Cobalt	mg/L	0.000383	0.000376	0.00052 J	0.00044 J	0.00047 J	0.00053 J					
Conductivity, Field	uS/cm	726	719									
Copper	mg/L			0.002 U	0.002 U	0.002 U	0.002 U					
Dissolved Oxygen, Field	mg/L	0.66	0.99						0.13			
Dissolved Solids, Total	mg/L	456	454	480	460	480 J	470 J	470	460	480	450	340
Fluoride	mg/L	0.09	0.3	0.098	0.095	0.096	0.095	0.1	0.095	0.11	0.083	0.083
Iron	mg/L			0.031 JB	0.1 U	0.1 U	0.1 U					
Lead	mg/L	2E-05	2.1E-05	0.00028 J	0.001 U	0.001 U	0.001 U					
Lithium	mg/L	0.005	0.006	0.0042 J	0.0033 J	0.0049 J	0.0053 J					
Magnesium	mg/L	14.2	12.8	14 B	14	15	14	14	14	14	15	
Manganese	mg/L			1.3 JB	1.5	1.4	1.5					
Mercury	mg/L	5E-06	5E-06	0.0002 U	0.0002 U	0.0002 U	0.0002 U					
Molybdenum	mg/L	0.00064	0.00128	0.00078 J	0.01 U	0.01 U	0.01 U					
Nickel	mg/L			0.00046 JB	0.002 U	0.002 U	0.002 U					
pH, Field	pH units	7	6.96	7.03	6.96	6.95	6.89		7.01	7.03	7.17	7.21
Potassium	mg/L	1.93	1.64	1.7 B	1.7	1.6	1.7	1.7	1.7	1.6	1.8	
Radium 226	pCi/L	0.31	0.141	0.0546 U	0.124	0.113	0.174					
Radium-226/228	pCi/L	1.032	0.249	0.283 U	0.159 U	0.665	0.259 U					
Radium-228	pCi/L	0.722	0.108	0.228 U	0.0352 U	0.552	0.0855 U					
Redox Potential, Field	mV	105.8	145.2									
Selenium	mg/L	4E-05	5E-05	0.005 U	0.005 U	0.005 U	0.005 U					
Silver	mg/L			4.4E-05 J	0.001 U	0.001 U	0.001 U					
Sodium	mg/L	14.4	10.8	13 JB	13 B	13	14 J	13	13	13	14	
Specific Conductivity, Field	uS/cm								729			
Strontium	mg/L	0.228	0.174	0.22 B	0.21 B	0.21 B	0.22					
Sulfate	mg/L	127	118	120	130	130	130	130	120	130	130	140
Temperature, Field	deg C	13.6	13.9						14.2			
Thallium	mg/L	2E-05	8.7E-05	0.001 U	0.001 U	0.001 U	0.001 U					
Turbidity, Field	NTU	4	1.6	0.2	0.2	1.5	2.4		2.19	0.97		4
Vanadium	mg/L			0.005 U								
Zinc	mg/L			0.02 U	0.02 U	0.02 U	0.02 U					

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